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MODEL 930A

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OPERATING MANUAL

930A
COMMUNICATIONS TEST SET

SAGE
INSTRUMENTS

WARRANTY

The SAGE Instruments 930A is warranted to be free from defects in materials or workmanship for a period of one year from the date of shipment. During the warranty period, SAGE will, at its option, either repair or replace products which prove to be defective at SAGE's expense.

Any repairs for damages from accident, misuse, shipment in other than approved packaging, or improper repair by other than SAGE Instruments' technicians or their authorized service facilities are not covered by this warranty. All out of warranty repairs will be done at the customer's expense based upon time and materials.

SAGE Instruments warrants that firmware provided for the 930A will execute its programming instructions when properly installed. SAGE does not warrant the operation of the instrument to be continuous or error free.
If improper operation of the Model 930A is suspected, contact SAGE Instruments at (408) 761-1000. Upon verification of problem with Customer Service, a Returned Material Authorization number will be issued for the instrument.

EXCLUSIVE REMEDIES

The remedies provided herein are the **original buyer's** sole and exclusive remedies. SAGE Instruments is not liable for consequential damages or damages to any party other than the **original buyer**. SAGE Instruments specifically disclaims any implied warranty of merchantability or fitness for a particular purpose. No other warranty is expressed or implied.

SHIPPING INSTRUCTIONS

After obtaining return material authorization number, ship the Model 930A, in its original container, postage prepaid, to:

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Include a detailed description of the problem and the conditions and circumstances under which the symptoms occurred. **IF THE ORIGINAL PACKAGING (OR APPROVED EQUIVALENT) IS NOT USED, THE WARRANTY WILL BE VOID.**

Dear Customer:

Thank you for your purchase of a Sage Model 930A. Please take a moment to fill out the **Warranty** card inside the front cover of the Operations Manual and return it to us. This is the only way we have of knowing where to send free software upgrades, additions to the Operation Manual, etc.

We want to ensure your continuing satisfaction with our product. If you should have any questions regarding the operation of the 930A please contact our **Customer Technical Support at (408) 761-1000.** The following SAGE area managers will be glad to arrange training for you or provide whatever after sales service you may need:

Joe Hurry 60 Evergreen Drive Southbury, CT 06488 (203) 262-6059	Responsible for the Northeast, Middle-Atlantic and Midwest States and Eastern Canada.
Mike Covington P.O. Box 1977 Sherman, TX 75091 (214) 893-2829	Responsible for the South, Southwest and Midwest states.
Don Lancaster 24184 Hansen Road Tracy, CA 95376 (209) 836-1515	Responsible for the Mountain States, the Pacific Northwest, California, Nevada, Alaska, and Western Canada.

You may want to check with us from time to time to see whether there have been improvements or additions to the Operating System software. The **Operating System** is **upgraded free** for the life of the instrument which is why we need to have you fill out the warranty card. Customer Service or Technical Support can arrange to send you new Firmware.

Should you ever encounter a malfunction, or if you suspect that your 930A is not operating correctly, please contact **Customer Service at (408) 761-1000** to obtain a **Return Material Authorization** number before sending back your unit. This helps us to identify the symptoms and expedite repairs.

Again, we at SAGE appreciate your business and customer satisfaction is our highest priority.

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SAGE INSTRUMENTS
MODEL 930A
COMMUNICATIONS TEST SET

OPERATIONS MANUAL

REVISION 3.0 7/30/90

SOFTWARE VERSIONS 3.25 AND ABOVE

SAGE INSTRUMENTS
240 AIRPORT BLVD.
FREEDOM, CA 95019-2614
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SECTION I
GENERAL INFORMATION

1-1 INTRODUCTION

This operating manual contains general information regarding the installation and operation of the SAGE Model 930A Communications Test Set. Figure 1-1 shows the instrument and optional accessories available.

1-2 SPECIFICATIONS

The instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested. Options for the instrument have separate specifications which are provided on supplementary specification sheets.

1-3 DESCRIPTION

The Model 930A Communications Test Set combines the functions of a Transmission Impairment Set, a Return Loss Measurement Set, Dial Pulse, Touch Tone (DTMF) and Multi-Frequency (MF) Sender, and Talk Battery supply into one lightweight package. Hardware and software options allow the user to greatly increase the capabilities of the 930A. These options include:

DP, DTMF, MF Receiver/Analyzer with Trunk Simulation
SF Supervision
P/AR Receiver/Transmitter
3-Level Impulse Noise
RS-232C Remote Control/Printer Interface
DS-1 PCM Transmit/Receive (Single or Dual Direction)
with D4/Superframe, Extended Superframe and SLC-96 Capability
Type 105 ROTL/Interrogator/Responder (52A Format)
Ring Generator/REN-3 Load
LTTP/STTP Interface (#1/1A ESS Switch)
FXO/FXS Supervision
Phase/Amplitude Jitter and Hits Measurement
Non-Linear Distortion Measurement
Envelope Delay Distortion Measurement
DS-0/DS-1 Bit Error Rate Testing

The Model 930A performs the three basic functions required of a **DEMARC** test set in today's environment. These are: Transmission Measurements, Signaling and Supervision, and T-1 PCM Drop/Insert (optional) testing.

The Model 930A has been designed to access and perform tests on the following types of circuits:

Equal Access (Feature Group D)
Centralized Automatic Message Accounting (CAMA)
Traffic Service Position System (TSPS)
Toll
International Direct Distance Dialing (IDDD)
Data
PBX
Private Line Automatic Ringdown (PLAR)
Manual Ringdown (MRD)
Foreign Exchange Office and Station ends (FXO/FXS) (optional)
DS-1 PCM Single Direction D4 Superframe and ESF (optional)
DS-1 PCM Dual Direction Drop/Insert D4 Superframe and ESF (optional)

The Model 930A can simulate the telephone company central office or the terminating end of the circuit (Customer Provided Equipment, an Inter-LATA carrier, DEMARC, or Point of Presence).

Sections IV, V, and VI of this manual describe the operation of the Options you may have purchased for the 930A.

The transmission measurements which the 930A can make are:

1. Level and Frequency
2. Noise (C-MSG, C-Notch, 3 KHz Flat and Signal-to-Noise)
3. Noise-to-Ground
4. Noise with Tone
5. Return Loss (2-Wire and 4-Wire)
6. DC Voltage and Current
7. P/AR (Option 930A-06)
8. 3-Level Impulse Noise & Hits (Option 930A-07 & -18)
9. Phase/Amplitude Jitter (Option 930A-18)
10. 4-Tone Intermodulation Distortion (Option 930A-20)
11. Envelope Delay Distortion (Option 930A-19)

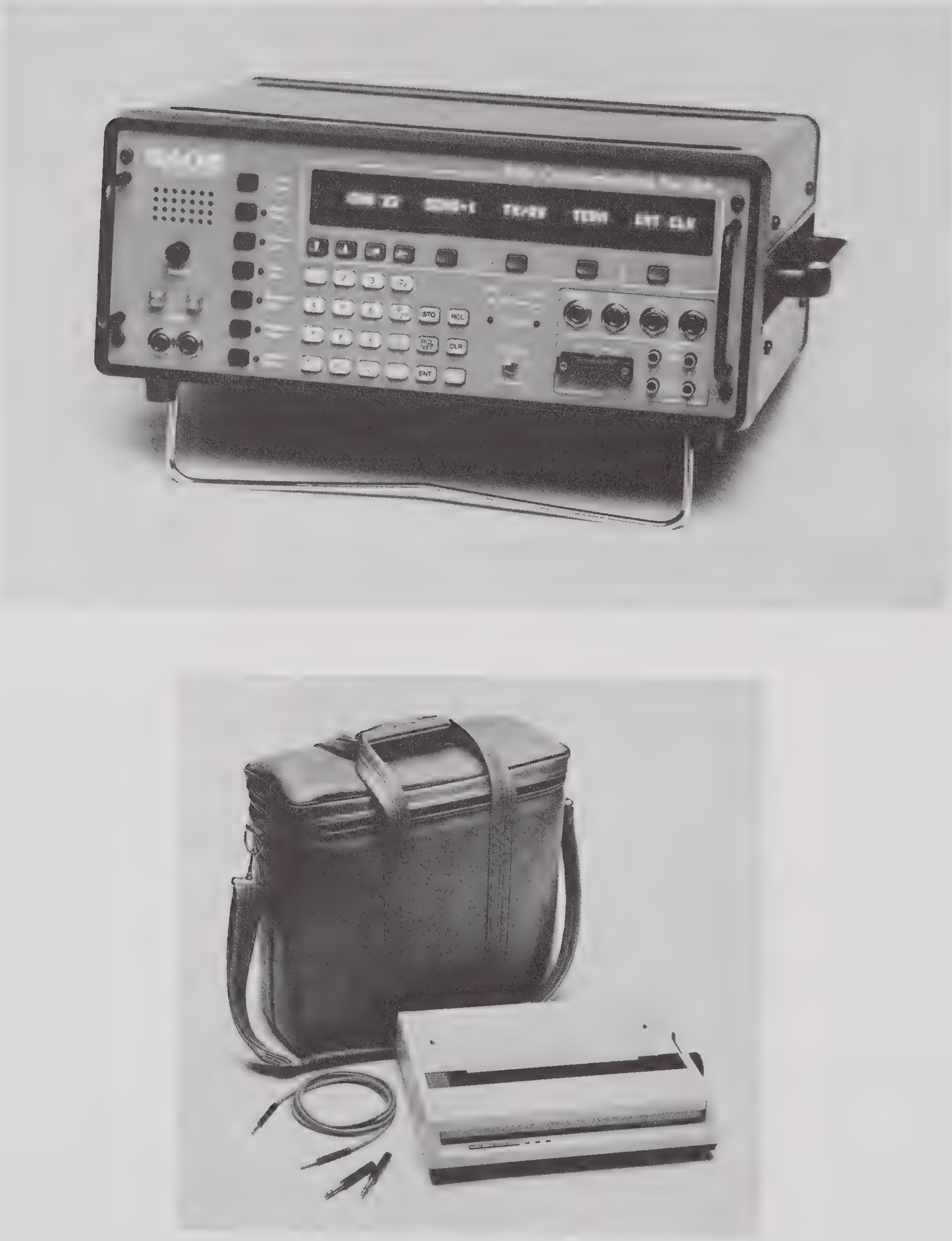
The signaling and supervision simulation capabilities of the Model 930A are:

1. 2- and 4-wire Loop Start (Normal and Reverse)
2. Ground Start (Normal and Reverse)
3. E&M signaling Types I, II, III, IV and V
4. Wink Start
5. Multi-Wink/Multi-Stage (Feature Group D, TSPS, etc.)
6. Delay Dial
7. SX supervision
8. DP, DTMF, and MF signaling sender
9. DP, DTMF, and MF Receiver/Analyzer (Option 930A-01)
10. SF supervision (Option 930A-02)
11. T-1 (Robbed Bit signaling) (Option 930A-08E or -09E)
12. FXO/FXS supervision on PCM trunks (Option 930A-25)

The Model 930A can also establish the talk path condition for transmission testing and has the ability to hold circuits for testing.

The T-1 facility testing capabilities of the 930A are:

1. Send and Receive patterns for DS-0/DS-1 Bit Error Rate Testing (Option 930A-22)
2. Count Slips, BPVs, Frame Errors and Losses, CRC Errors (Option 930A-08E or -09E)
3. Provide detailed error history (Option 930A-22)
4. Measure T-1 voltage at the DSX (Option 930A-08E or -09E)
5. A, B, C & D Bit Timing (Option 930A-08E or -09E)



MODEL 930A AND ACCESSORIES
FIGURE 1-1

1-4 A WORD ABOUT SOFTKEY CONTROLLED TEST SETS

As you can see from glancing at Figure 1-1, the 930A front panel has push-buttons for everything. With all microprocessor controlled equipment, you have the advantage of placing a lot of functions into one compact package. You have to get used to using a single front panel to operate what, in the old days, was four or more separate instruments. In order to accomplish this feat, and still have a reasonably sized instrument, a bit of ingenuity is required. Most manufacturers, SAGE included, have chosen to use the **"softkey"** approach.

What this means is that the four unlabeled keys, directly below the display, and to the right of the arrow keys, change their definition with each new display. **The display above the key** at any particular time defines that keys function at that instant.

In the 930A, every attempt has been made to have the unit operate in a logical manner. For example, when you turn on the 930A, the first thing it does is power up to the last trunk type you selected. It wants to give you the opportunity to change to another trunk type. Since the 930A operates on so many different trunk types, and it can simulate either the office or subscriber ends of each type, this is a valid question. Also, the 930A sets many of its defaults, such as Transmission Level Points (TLP), depending on the trunk type you select.

The layout of the front panel is intended to be logical so the major functions (Trunk Type, Dial/Ring, etc.) are grouped separately from the Numeric Keypad and the Special Function keys. Once the desired function key has been pressed and the LED beside it lights, control within that function passes to the arrow keys and softkeys under the display.

If you keep this in mind it will make learning and using the 930A a bit easier. Just in case, there is a front panel **HELP** key which provides step-by-step prompts for operating each function (except the **OPTION MENU** Function key). The display will have a flashing cursor over the currently selected parameter for each step. If you want that particular choice you press the softkey under it. If you do not want it, you press the softkey under the choice you do want. The screen will advance to the next item for you to select, and so on, until the function has been set up. The display will then return to the function's main screen.

1-5 ACCESSORIES AVAILABLE

The following accessories are available:

1. 80 Column Dot Matrix Printer and Cable,
   SAGE P/N 9400-0001-01
2. Test Cord, bantam male to bantam male, 96 inches
   SAGE P/N 9400-0002-01
3. Adapter , 310 male to bantam female,
   SAGE P/N 9400-0003-01
4. Test Cord, 310 male to 310 male, 60 inches
   SAGE P/N 9400-0004-01
5. Test Cord, 310 male to alligator clip, 60 inches
   SAGE P/N 9400-0005-01
6. Test Cord, 310 male to bantam male, 96 inches
   SAGE P/N 9400-0006-01
7. Standard 19-inch rack mounting kit,
   SAGE P/N 9400-1001-01
8. Standard 23-inch rack mounting kit,
   SAGE P/N 9400-1002-01
9. Padded Vinyl Carrying Case,
   SAGE P/N 9400-1003-01
10. Industrial Grade Shipping Case,
    SAGE P/N 9400-1004-01
11. Front Panel Cover,
    SAGE P/N 9400-1005-01
12. Calibration Kit
    SAGE P/N 9400-0012-01

1-6 WARRANTY

Warranty information is listed on the inside of the front cover.

TABLE 1-1 *Specifications*

LEVEL/FREQUENCY

TRANSMITTER

Frequency Range:	20 Hz to 5000 Hz
Resolution:	1 Hz
Accuracy:	± 1.0 Hz
Output Steps:	1 Hz, 10 Hz, 100 Hz, or 1000 Hz steps
Frequency Sweep:	Single or Continuous with selectable bounds, level and step size.
Level Range:	- 60 dBm to + 12 dBm
Resolution:	0.1 dB
Accuracy:	± 0.1 dB @ 1004 Hz (0 to -19 dBm),
Flatness:	± 0.2 dB (200 Hz to 5 KHz referenced to level at 1 KHz)
Distortion:	- 70 dB @ 1004 Hz, 0 dBm

RECEIVER

Frequency Range:	20 Hz to 5000 Hz
Resolution:	1 Hz
Accuracy:	± 1.0 Hz
Level Range:	- 50 dBm to + 12 dBm
Resolution:	0.1 dB
Accuracy:	± 0.1 dB @ 1004 Hz (0 to -19 dBm), ± 0.2 dB @ 200 Hz to 5 Khz

NOISE MEASUREMENTS

Input:	Balanced or Noise to Ground
Weighting Filters:	C-MSG, C-NOTCH, 3 KHz Flat
Notch Filter:	1010 Hz (995 Hz to 1025 Hz Notch); > 60 dB Notch depth
Range:	10 dBrn to 100 dBrn (Balanced) 50 dBrn to 130 dBrn (Noise to Ground)
Resolution:	1.0 dB
Accuracy:	± 0.5 dB

TABLE 1-1 *Specifications (con't)*

SIGNAL-TO-NOISE MEASUREMENT

Level Range:	-50 dBm to +10 dBm
Noise Range:	10 dBrn to 90 dBrn
S/N Range:	10 dB to 70 dB
Accuracy:	± 0.5 dB
Resolution:	1.0 dB

RETURN LOSS MEASUREMENT

Modes:	ERL, SRL-Low, SRL-High or Sinewave (OSCillator mode)
Transmitted Signal:	Meets the specifications of Bell Publication 41009 (Tables D, E and F, page 13) and IEEE Standard 743-1984

2-WIRE RETURN LOSS

Transmitter Level:	-10 dBm0
Receiver Range:	0 dB to 40 dB
Resolution:	1.0 dB
Accuracy:	± 0.5 dB
Internal Hybrid Impedance:	600 or 900 ohms ± 0.1% in series with 2.16 uF ± 1%

4-WIRE RETURN LOSS

Impedance:	150, 600, 900, or 1200 ohms
Transhybrid Loss Compensation:	- 30 dB to + 30 dB
Transmitter Level:	- 10 dBm0 In OSCillator mode the level is 0 dBm relative to the TLP.
Receiver Range:	-10 dB to 50 dB
Resolution:	1.0 dB
Accuracy:	± 0.5 dB

TABLE 1-1 *Specifications (con't)*

SUPERVISORY SIGNALING

WINK TIMING

Resolution:	5 msecs.
Accuracy:	± 5 msecs.
Wink Fail Event:	Fails for wink period >600 msecs.
Off-Hook Fail Event:	Fails for Off-Hook period <600 msecs.

E/M SUPERVISION

Types:	I, II, III, IV, V
Battery:	- 48 VDC current limited to 200 mA
Threshold Voltages:	

	E Lead	**M Lead**
On Hook	< - 16 V.	> - 16 V.
Off Hook	> - 16 V.	< - 16 V.

LOOP SUPERVISION

Types:	2- and 4-wire Loop Start, Ground Start, Loop Reverse Battery, and SX supervision.
Battery:	- 48 VDC series limited to 120 mA

MF AND DTMF SENDER

Frequency Accuracy:	± 0.1% of Bell Standard Frequencies
Adjustment Range:	Tone Frequencies adjustable in 0.1% steps to ± 10% of standard Bell frequencies for Margin Testing.
Level:	Automatically adjusted to -7 dBm0.
Level Adjustment Range:	Tone level adjustable in 0.1 dB steps from - 60.0 dBm to + 6.0 dBm.

TABLE 1-1 *Specifications (con't)*

Resolution:	0.1 dB
Accuracy:	± 0.2 dB
Timing:	MF: 70 ms Tone On and Tone Off (KP is 100 mS Tone On) DTMF: 50 ms Tone On and Tone Off
Timing Adjustment Range:	Tone On and Tone Off times adjustable in 1 ms steps from 13 msecs. to 267 msecs.
Resolution:	1 msecs.
Accuracy:	± 1.0 msecs.

DIAL PULSE SENDER

PPS

Range:	2 to 50 PPS
Resolution:	0.1 PPS
Accuracy:	± 1.0% at 10 PPS

% BREAK

Range:	5 to 95%
Resolution:	0.1%
Accuracy:	± 1.0% for 25% to 75% BRK @ 10 PPS

INTERDIGIT TIMING

Range:	40 to 990 msecs.
Resolution:	10 msecs.
Accuracy:	± 5 msecs.

TABLE 1-1 *Specifications (con't)*

GENERAL

Impedances:	150, 600, 900, 1200 ohms and > 50 Kohms Bridging
Maximum DC Blocking:	160 VDC
Audio Bandwidth:	± 3.0 dB 300 Hz to 3.0 KHz
Audio Volume:	Adjustable by front panel control
Longitudinal Balance:	90 dB at 60 Hz
Receiver Return Loss:	> 30 dB 200 Hz to 5 KHz (600, 900, 1200 ohms) > 30 dB 800 Hz to 5 KHz (150 ohms)
Display:	40 character vacuum fluorescent plus 4 LED's for ON/OFF Hook status
AC Power Supply:	115 VAC ± 10%, 60 Hz
Operating Temperature:	0° C to 50° C
Storage Temperature:	- 40° C to 70° C
Dimensions:	5.79" H. x 14.33" W. x 14.25" D.
Weight:	16 to 18 lbs. depending upon options.

OPTIONS

MF/DTMF/DP RECEIVER AND ANALYZER (OPTION 930A-01)

MF AND DTMF

Input Level Range:	-25 dBm to 0 dBm
Accuracy:	± 0.2 dB
Resolution:	0.1 dB
Input Frequency Range:	± 10% of AT&T standard frequencies for MF and DTMF tones.
Accuracy:	± 0.1%
Resolution:	1 Hz
Input Tone ON/OFF Range:	35 msecs. to 250 msecs. Tone ON 35 msecs. to 250 msecs. Tone OFF
Accuracy:	± 5 msecs.
Resolution:	1 msecs.

TABLE 1-1 *Specifications (con't)*

DIAL PULSE (DP) RECEIVER AND ANALYZER (OPTION 930A-01)

PPS Range:	5 PPS to 30 PPS
Accuracy:	± 2% @ 10 PPS
Resolution:	0.1 PPS
% Break:	10% to 90%
Accuracy:	± 2% (25% to 75% break at 10 PPS)
Resolution:	0.1%
Interdigit Timing Range:	50 msecs. to 990 msecs.
Accuracy:	± 5 msecs.
Resolution:	1 msec.

SF SUPERVISION (OPTION 930A-02)

SF Oscillator:	2604 Hz, ± 1.0 Hz
Send Level:	-36 dBm0 On Hook, -13 dBm0 pulse
Receiver Sensitivity	-42 dBm0

PEAK TO AVERAGE RATIO (P/AR) (OPTION 930A-06)

Transmit Level Range:	0 dBm to -40 dBm
Resolution:	0.1 dB
Receive Level Range:	-40 dBm to +12 dBm
Resolution:	0.1 dB
P/AR Measurement Range:	0 to 120 P/AR units
Resolution:	1 P/AR unit
Accuracy:	± 1 P/AR unit

3-LEVEL IMPULSE NOISE (OPTION 930A-07)

Weighting Filter:	C-Notch
Threshold Range:	30 dBrnC to 106 dBrnC
Accuracy:	± 1.0 dB
Threshold Spread:	2, 4, 6, or 8 dB steps
Timer:	1 min. to 99 mins. or continuous
Counter Capacity:	0 to 9999 for LO, MD and HI.
Measurements Range:	7 to 99 measurements per second.

TABLE 1-1 *Specifications (con't)*

DS-1 PCM DROP/INSERT OPTIONS (OPTIONS 930A-08E AND -09E)

Format:	DS-1 AMI or B8ZS Line Code
DS-1Input Frequency:	1.544 Mbps ± 15 Kbps
Jitter Tolerance:	Exceeds Bell Pub 43802 Requirements
Channel Numbering Sequence:	D1D, D2, D3/D4/D5
Signaling Mode:	NORM (Robbed Bit) or CCIS
Framing Format:	D4 Superframe, Extended Superframe or SLC-96
Selection:	Automatic or manual selection of frame format-D4/SF or ESF
Input Mode:	Terminated: 100 ohms nominal Bridging: >1000 ohms
Input Level:	200 mV to 6.0 V. base to peak
Input Level Measurement:	200 mV to 6.0 V. ± 50 mV base to peak or -23 dBSX to +3 dBSX ±1 dB
DS-1 Output:	1.544 Mbps ± 40 bps (Stratum 4) in INTERNAL Clock mode. Output rate equal to input rate in LOOP TIMED mode.
Frequency Skew:	Output frequency can be shifted by 100 bps in INTERNAL Clock mode to verify far end loop timed status.
Output Pulse Level:	3.0 V. nominal base to peak into 100 ohms resistive load
Output Imbalance:	Positive and Negative pulses are within 0.2 V. base to peak
Channel Selection:	Any one of 24 selectable from keypad.
PCM Supervision Displays:	40 character vacuum fluorescent display shows A and B bit signaling states for all 24 channels (Menu Option #20) simultaneously. In ESF mode A, B, C and D bits are displayed. 4 LED's show status of ON/OFF Hook supervision of selected time slot.
Operating Modes:	TERMINATE, MONITOR 1, MONITOR 1&2 DROP&INSERT (Opt.930A-09E) with front panel selection of receive direction.
Pattern Simulation:	Idle Code (All Ones) Received PCM (MONITOR Mode)

TABLE 1-1 *Specifications (con't)*

Operating Modes:	TERMINATE: selected channel is connected to channel generator and receiver. Other 23 channels send IDLE code (All Ones) MONITOR: monitor selected channel in one or both directions. All 24 channels pass through unchanged. Framing is regenerated. DROP&INSERT: dual direction only. Selected channel dropped out for testing. Other 23 channels pass through unchanged. (Option 930A-09E)
Pattern Simulation:	Idle Code (All Ones), Received PCM Optional patterns require Option 930A-22 Bit Error Rate testing.
Frame Loss Criteria:	Loss of frame occurs when 2 out of 4 F_t bits are in error for Superframe and SLC-96. Loss of frame for ESF occurs when 2 out of 4 FPS bits are in error.
Error Displays:	Detects and counts Frame Errors, Bipolar Violations, Frame Slips and CRC Errors (ESF Only).
Alarms:	Sends Blue Alarm (All Ones) or Yellow Alarm (ALL Bit#2=0 on Superframe and sent on Facility data Link for ESF.
Alarm Displays:	Detects and displays Frame Loss, Carrier Loss, Excess 0's, Yellow and Blue Alarms.

PCM CHANNEL ENCODER

Analog Tone Generation:	20 Hz to 3904 Hz selectable in 1.0 Hz steps from keypad
Tone Level:	+3.0 dBm to -50.0 dBm in 0.1 dB steps selectable from keypad
Frequency Response:	± 0.1 dB (20 Hz to 3904 Hz)

Basic Accuracy:

Accuracy	Level
± 0.1 dB	+3.0 dBm0 to -30 dBm0
± 0.2 dB	-30 dBm0 to -40 dBm0
± 0.5 dB	-40 dBm0 to -50 dBm0

TABLE 1-1 *Specifications (con't)*

Supervision:	NORMAL (E&M), USER DEFINED states of A and B bits (C and D bits in ESF). FXO/ FXS simulation (Option 930A-25)
Signaling:	MF, DTMF and DP

PCM CHANNEL DECODER

Recovered Analog Tones:	20 Hz to 3904 Hz, ± 1 Hz
Recovered Level:	+3.0 dBm to -40.0 dBm

Basic Accuracy: ± 0.1 dB with Digital Milliwatt

Accuracy	Input Level
± 0.1 dB	+3.0 dBm0 to -30 dBm0
± 0.2 dB	-30 dBm0 to -40 dBm0
± 0.5 dB	-40 dBm0 to -50 dBm0

Frequency Response:	± 0.1 dB @ 204 Hz to 3904 Hz with 0 dBm applied.
Supervision:	On-Hook and Off-Hook supervision are user definable as any combination of A, C and B, D bits (i.e., 0, 1, or "don't care"). FXO/FXS supervision available with Option 930A-25.

Signal to Total Distortion:

Input	7 5/6 Sgnlng	CCIS
0 to -30 dBm0	38 dB	40 dB
-30 to -40 dBm0	36 dB	36 dB
-40 to -50 dBm0	32 dB	32 dB

Gain Tracking Error:

Input	Max. Deviation
+3.0 to -30 dBm0	± 0.1 dB
-30 to -40 dBm0	± 0.2 dB
-40 to -50 dBm0	± 0.5 dB

Intrinsic Noise:	10 dBrnC (with Idle Code received)

TABLE 1-1 *Specifications (con't)*

PHASE/AMPLITUDE JITTER AND HITS (OPTION 930A-18)

Phase and Amplitude Jitter Measurement

Received Holding Tone Level: +10 dBm to -40 dBm (Metallic)
0.0 dBm to -40 dBm (PCM)
Holding Tone Frequency Range: 990 Hz to 1030 Hz
Phase Jitter Measurement: 0.0° to 30.0° peak to peak
Accuracy: ± 5%, ± 0.2°
Amplitude Jitter Measurement: 0.0% to 30.0% peak
Accuracy: ± 5%, ± 0.2%
Weighting Filter Bandpass: 4 Hz to 300 Hz and 20 Hz to 300 Hz

Transients (Hits) Measurements*

Phase Hits: 5° to 50° peak in 1° steps
Gain Hits: ± 1 to ± 10 dB in 1 dB steps
Dropouts: Tone level drops below 12 dB, ±1 dB
Guard Interval: Per IEEE STD. 743-1984 Figs. 6 and 7
Timer: Same as Impulse Noise
Count Rate: Same as Impulse Noise
Counter Capacity: Same as Impulse Noise

* Option 930A-18 requires that Option 930A-07 (Impulse Noise) be installed as well. The Impulse Noise counts are interlocked with the transient measurements in accordance with IEEE specifications.

ENVELOPE DELAY DISTORTION MEASUREMENT (OPTION 930A-19)

Modes: SEND and REPEAT (Master and Slave)

Transmitter: 50% AM signal at modulation frequency of $83\,^{1}/_{3}$ Hz.

Carrier Frequency: 304 Hz to 3504 Hz, ± 2 Hz
Carrier Level: 0.0 dBm to -40 dBm (Metallic)
0.0 dBm to -40 dBm (PCM)
Flatness: ± 0.2 dB (304 to 3504 Hz)

TABLE 1-1 *Specifications (con't)*

Receiver Input Level:	+10 dBm to -40 dBm (Metallic) 0.0 dBm to -40 dBm (PCM)
Distortion Measurement range:	+9000, -3000 µseconds
Accuracy:	± 10µs 604 Hz to 3504 Hz ± 30µs 304 Hz to 603 Hz

INTERMODULATION DISTORTION (OPTION 930A-20) *

Transmitter Spectrum:	Four equal level tones (857, 863, 1372 and 1388 Hz)
Harmonic distortion:	>35 dB below tone level
Transmitter Level Range:	0 dBm to -40 dBm RMS (Metallic) -6 dBm to -40 dBm RMS (PCM)
Accuracy:	± 1 dB
Receiver Input Level:	0 dBm to -40 dBm RMS (Metallic) -6 dBm to -40 dBm RMS (PCM)
Distortion Products:	2nd Order centered at 520 and 2240 Hz 3rd Order centered at 1900 Hz
Distortion Range:	10 dB to 70 dB below signal-2nd Order 10 dB to 70 dB below signal-3rd Order
Resolution:	1 dB
Accuracy:	± 1 dB
Signal to Noise Test:	Removes Low Tone pair and increases level of remaining tone pair by 3 dB.

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* Licensed under Hekimian Laboratories, Inc. Patent No. 3, 862, 380

TABLE 1-1 *Specifications (con't)*

DS-0/DS-1 BIT ERROR RATE TESTING (OPTION 930A-22)

DS-1 BERT SPECIFICATIONS

Input:	See Option 930A-08E/09E specifications
Output:	See Option 930A-08E/09E specifications
Framing:	Patterns may be framed (D4 or ESF) or unframed.
Test Patterns:	Pseudo-random bit sequences (PRBS) of the following lengths may be sent and received: 2^9-1 (511) 2^{11}-1 (2047) 2^{15}-1 2^{20}-1 QRSS (2^{20}-1 with 14 zero suppression) 2^{23}-1
Stress Patterns:	3 in 24 bits (100010001000000000000000) 1 : 7 bits (10000000) 1 : 1 bits (1010) All 1's 55 OCTETS (440 bit pattern for Multiplexer Testing)
User-Defined Patterns:	User may input any bit sequence length from 1 to 24 bits (even numbers from 18 to 24) Pattern will continuously repeat
Loopback Codes:	Send and Receive CSU loop codes: Loop Up= 10000 continuous for 8 seconds Loop Down= 100 continuous Other Loop codes can be sent and received by editing the above patterns.
Error Injection:	Inject single logic errors, bipolar violations, frame errors (D4 mode) or CRC errors (ESF mode).

TABLE 1-1 *Specifications (con't)*

DS-1 BERT SPECIFICATIONS (Continued)

PRBS Receiver Sync:	128 consecutive error-free bits must be received to achieve synchronization. BER of greater than 10^{-1} for 320 milliseconds causes sync loss and resync attempt.
Pattern Sync:	386 consecutive bits with less than 10^{-2} error rate must be received to achieve pattern sync. BER of greater than 10^{-2} for 2 milliseconds causes sync loss and resync attempt.
Measurements:	Measures and displays: Bit (Logic) Errors, Bit Error Rate, Bit Slips, Bipolar Violations (BPV), Frame Errors, Frame Losses, Frame Slips, CRC Errors (ESF mode), Errored Seconds, % Errored Seconds, Error Free Seconds, % Error Free Seconds, Severely Errored Seconds, % Severely Errored Seconds, Failed Seconds, % Failed Seconds, Unavailable Seconds, % Unavailable Seconds, % Availability, No Sync, Test Length, Clock Time/Date, Elapsed Time.
Test Length:	Timed or continuous
Timed Test Length:	15 minutes, 1 hour or 24 Hours.

DS-0 BERT SPECIFICATIONS

56 KBps Mode:	Selected when 930A is set to “Robbed Bit” signaling. Least significant bit of channel under test is always set to 1.
64 KBps Mode:	Selected when 930A is set to either B8ZS (Clear Channel) line code or CCIS signaling.
Test Patterns:	Pseudo-random bit sequences (PRBS) of the following lengths may be sent and received: 2^9-1 (511) 2^{11}-1 (2047)

Stress Patterns:	1 : 7 bits (10000000) 1 : 1 bits (1010) All 1's All 0's
User-Defined Patterns:	User may input any bit sequence length from 1 to 8 bits Pattern will continuously repeat
Loopback Codes:	Send and Receive CSU/DSU/OCU loop codes in 56 KBps mode. LSB of selected channel byte is always set to 0. Cannot be used with switched 56 KBps channels using robbed bit signaling.
Error Counters:	All DS-1 errors (i.e., BPV errors, frame errors, CRC errors, Slips, etc.) are recorded for the entire DS-1. Bit Errors and Bit Error Rate are calculated on the received DS-0 channel selected. CCITT G.821 Error statistics are based on the bit errors of the selected DS-0 channel received.
Error Injection:	Inject single bit errors.

SECTION II
INSTALLATION

2-1 INTRODUCTION

This section provides information regarding initial inspection and damage claims, preparation for operation, power requirements, storage and shipment. Also provided is a physical description of the Model 930A.

2-2 INITIAL INSPECTION

When the instrument arrives, inspect the shipping container for visible signs of stress or damage. If the shipping container, or packaging material, is damaged, **notify the carrier,** as well as **SAGE**, immediately. Retain the materials until the contents have been checked mechanically and electrically. The contents of the shipment should be: One Model 930A, one copy of the Operating Manual, and one AC power cord. Accessories may, or may not, be shipped in the same container as the Model 930A, depending upon their size. Check the shipping invoice carefully against the contents received.

2-3 PREPARATION FOR USE

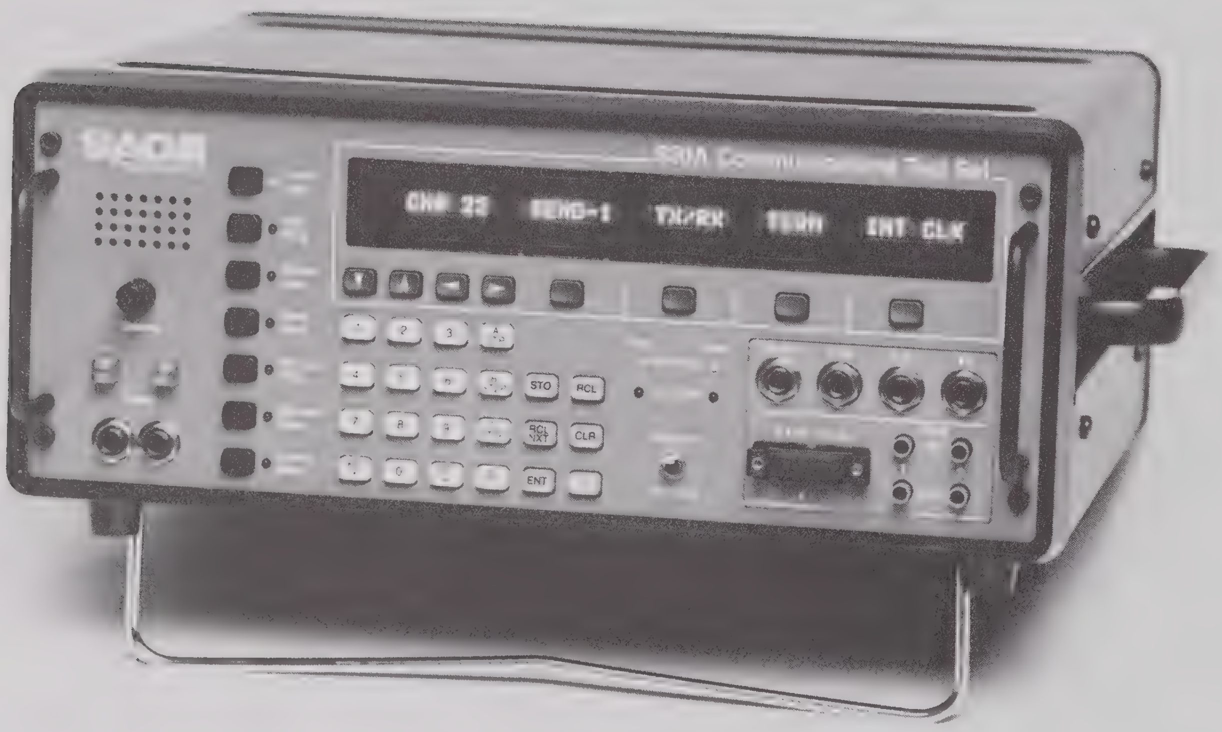
CAUTION

> This instrument is designed to operate on 115 VAC, 60 Hz power. Connection to a power source other than this will cause damage to the Model 930A. Consult the factory for optional power sources.

Connect the Model 930A to any standard three conductor outlet of 115 VAC, 60 Hz using the power cord supplied with the unit. The three wire power cord supplied with the unit grounds the instrument.

WARNING

> Do not interrupt the protective (ground) conductor (inside or outside the instrument), or disconnect the protective earth terminal, as this can make the instrument an electrical shock hazard.



SAGE INSTRUMENTS MODEL 930A
FIGURE 2-1

2-4 OPERATING ENVIRONMENT

This instrument may be operated in temperatures from 0 degrees C to 50 degrees C (+ 32 degrees F to + 122 degrees F). The instrument will operate in environments with humidity from 10 to 90% relative humidity, non-condensing, at +40 degrees C (104 degrees F).

2-5 STORAGE AND SHIPMENT

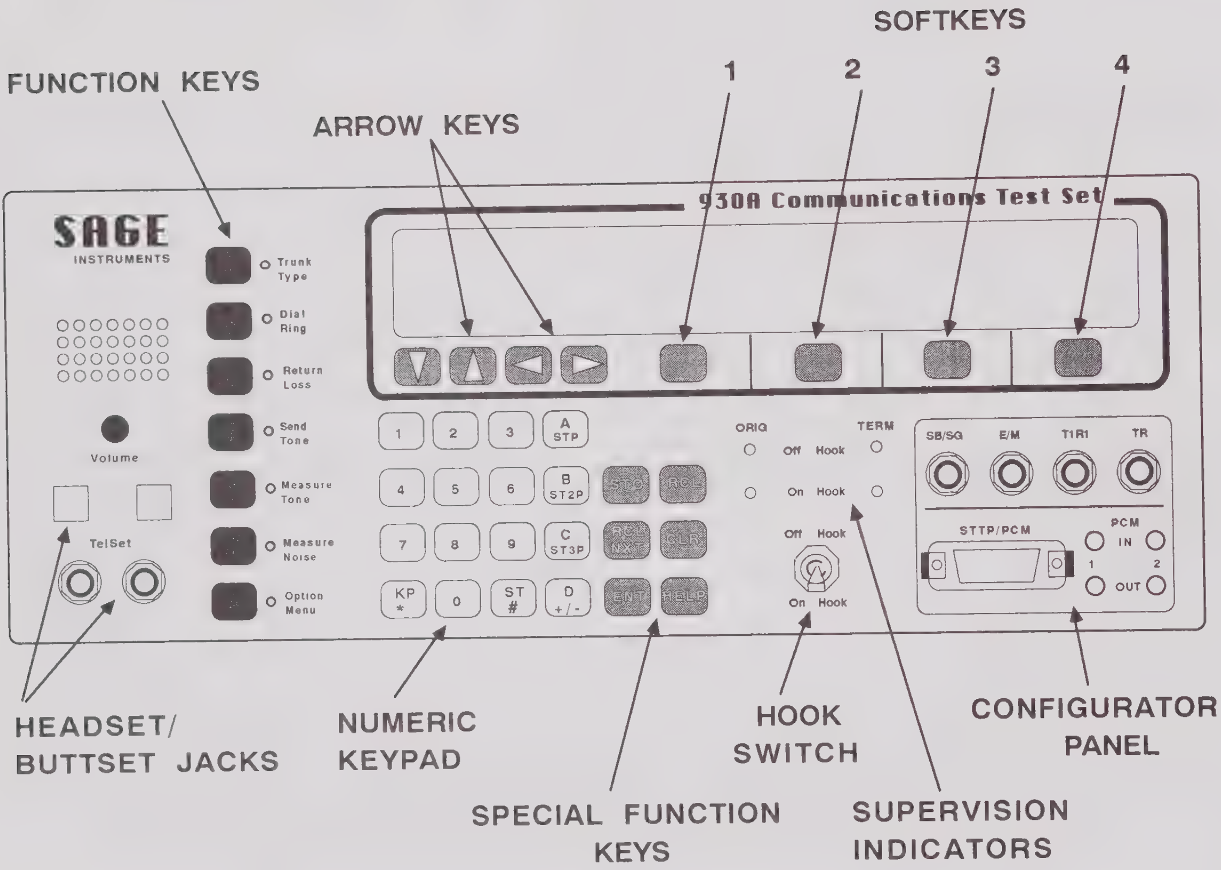
The instrument may be stored and shipped within the following environmental limits:

*	Temperature	-40 to +70 degrees C
*	Humidity	Up to 90% Relative @ +65 degrees C

If possible, retain the original shipping container and packing materials. If you should ever have to return your 930A to SAGE, the original packaging will protect the instrument. In the event that the original container is no longer available, the following general instructions should be used for repackaging the instrument with commercially available materials.

1. Include return address, serial number, returned material authorization number, and the name of a technical contact when returning instrument for service.
2. Use a double-walled carton of at least 350 pound test material. Dimensions must be 21"L.x19.5"W.x14.25"H. to provide space for shock-absorbing material.
3. Use a 3-4 inch layer of shock absorbing foam material (**Do not use "popcorn" foam**) on all sides, top, and bottom of the instrument. Protect the front panel with cardboard.
4. Seal the container securely.
5. Mark the container **FRAGILE** to ensure careful handling. Write the **RMA** number under the address.
6. Refer to the instrument model number and serial number in any correspondence.

The instrument warranty will be voided if an instrument is returned and found to be improperly packaged.



MODEL 930A FRONT PANEL
FIGURE 2-2

2-6 PHYSICAL DESCRIPTION

The SAGE Instruments Model 930A shown in Figure 2-1 measures 5.79" H. x 14.33" W. x 14.25" D. A convenient carrying handle extends 1.25" from the right side of the instrument case. Two smaller carrying handles extend 1.25" from the front panel of the Model 930A. Four rubber feet extend 0.5" from the left side of the case. Four large plastic feet extend 1" from the rear panel of the unit permitting the operator to set the unit on end when performing tests at the DSX jackfield. The unit normally sits on the four plastic feet which extend 0.5" from the bottom of the case. For ease of viewing, the Model 930A is equipped with a pivot brace inside the front feet. This raises the front of the unit three inches when extended.

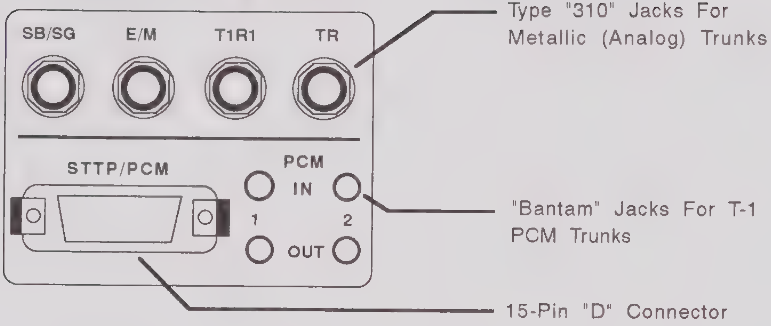
The front panel shown in Figure 2-2 measures 5.25" H. x 13.5" W. It contains 37 keys, 11 LED's, a speaker grill, a volume control knob, two carrying handles, a hook switch, a 2.25" x 3.25" configurator panel which contains the input/output connectors, a 40 character alphanumeric Fluorescent Indicator Panel, and connectors for a headset and butt-in.

The configurator panel is located in the lower right side of the front panel as shown in Figure 2-2. Depending upon which configurator has been ordered, it will contain some combination of 310 jacks, bantam jacks, 5-way binding posts, or a 15 pin subminiature D type connector. Various configurators are shown in Figure 2-3.

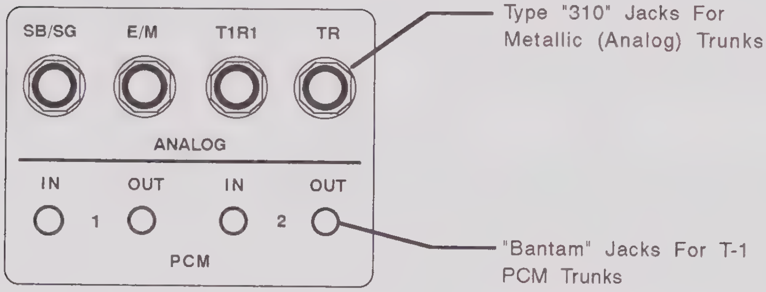
The **"A"** configurator is used in units intended for entirely analog operation and having no T-1 PCM options. The Type 310 jacks are for the analog input/output and are labeled **SB/SG** (Signal Battery/Signal Ground), **E/M** (The E and M leads), **T/R** (Tip and Ring), and **T1/R1** (Tip-1 and Ring-1). The **E/M** and **SB/SG** leads are used for **E&M** signaling. **TR** and **T1R1** are used by all 4-wire analog trunks. All 2-wire signaling and transmission is done over **TR**. The binding posts, below their corresponding 310 jacks, are labeled **SG, SB, E, M, T, R, T1,** and **R1**.

The **"A/P"** configurator is intended for use in those units which have both analog and digital (**T-1 PCM**) capability. That is, Option 930A-08E or -09E has been installed. The bantam, or tiny telephone, jacks provide digital access for the **PCM** trunks. They are labeled **PCM1 IN, PCM1 OUT, PCM2 IN,** and **PCM2 OUT**. The **"310 A/P"** is the same except all jacks are Type 310.

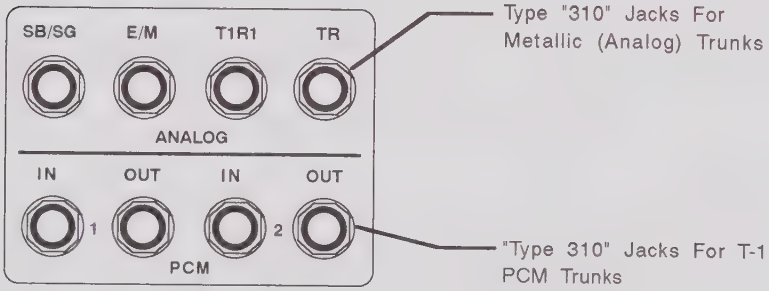
UNIVERSAL I/O MODULE


SB/SG
E/M
T1R1
TR
STTP/PCM
PCM
IN
1
2
OUT
Type "310" Jacks For Metallic (Analog) Trunks
"Bantam" Jacks For T-1 PCM Trunks
15-Pin "D" Connector

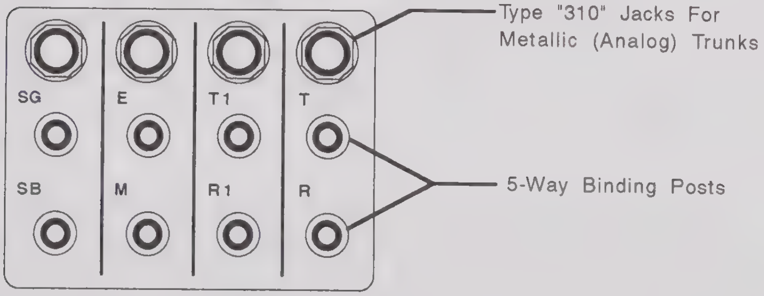
ANALOG/PCM I/O MODULE


SB/SG
E/M
T1R1
TR
ANALOG
IN
OUT
IN
OUT
1
2
PCM
Type "310" Jacks For Metallic (Analog) Trunks
"Bantam" Jacks For T-1 PCM Trunks

310 ANALOG/PCM I/O MODULE


SB/SG
E/M
T1R1
TR
ANALOG
IN
OUT
IN
OUT
1
2
PCM
Type "310" Jacks For Metallic (Analog) Trunks
"Type 310" Jacks For T-1 PCM Trunks

STANDARD ANALOG I/O MODULE



CONFIGURATOR PANELS
FIGURE 2-3

The **"UNIV"** configurator is intended for use with analog/digital trunks and also has a 15 pin subminiature D type connector for use with the SAGE Model 114A Supplementary Trunk Test Panel Adapter. This would mean that Option 930A-14 has been installed.

The rear panel shown in Figure 2-4 measures 5" x 13.5" and contains the following:

- ON/OFF Switch
- Recessed connector for three-prong power cord
- Fuse Holder
- Fan Grill
- Grounding Lug
- 25 pin RS-232C "D" type connector (optional)
- Four plastic feet with soft rubber tips

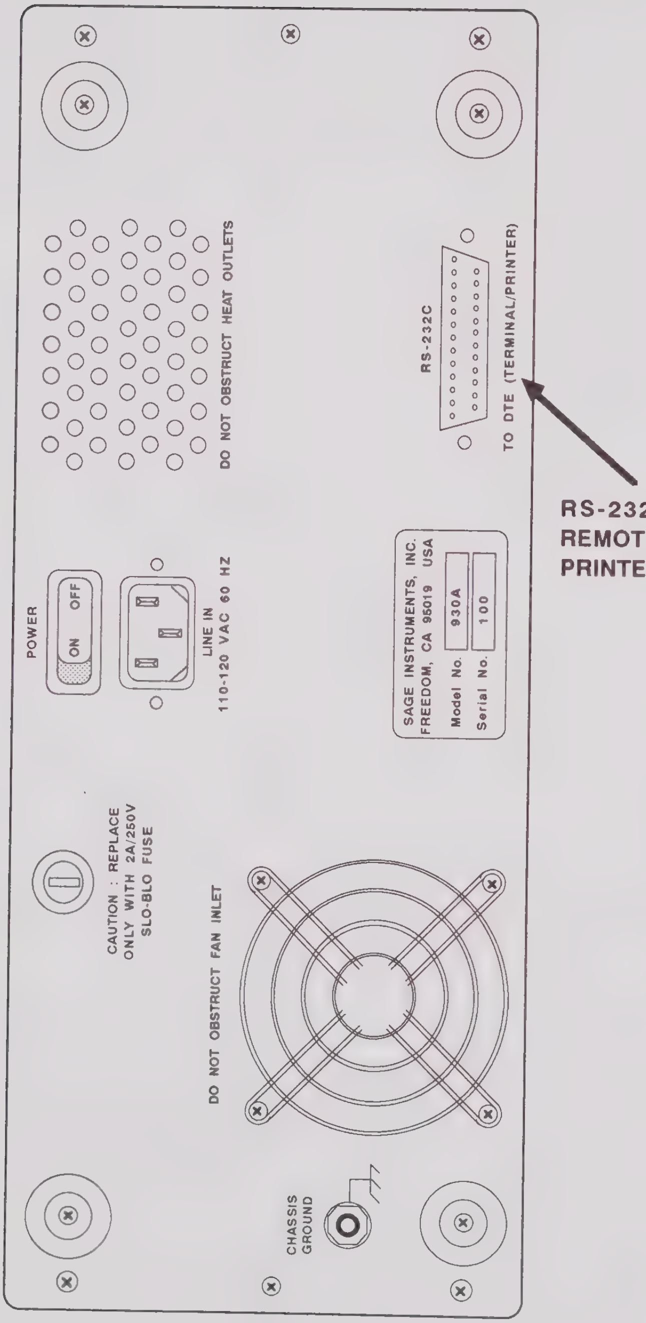
The **ON/OFF** switch controls power to the 930A. It is located at the top center of the rear panel as shown in Figure 2-4. The AC power connection is located directly beneath the **ON/OFF** switch and is intended for use only with the power cord supplied with the unit.

The fuse holder is spring loaded. To gain access to the fuse, insert a flat blade screwdriver into the fuse holder slot and make a 1/4 turn counterclockwise. The fuse is a 2 Amp Slow-Blow. If a power surge causes the fuse to fail, be sure to replace it **ONLY** with a fuse of the same rating, and **ONLY** after determining that the condition which caused the failure no longer exists.

The fan grill allows access for cooling air into the Model 930A. **Do not** block the air intake, place it adjacent to a heating duct, or operate the unit standing on it's rear panel on a thick carpet. Holes drilled in the upper right side of the rear panel are intended for the exit of warm air. These should not be blocked, or damage to the Model 930A will result.

The rear panel plastic feet support the 930A on a level surface for operator convenience. **DO NOT** place an operating 930A on thick carpets, or on surfaces that are thick with dust, as access to the fan grill may be blocked.

The grounding lug, located at the lower left edge of the rear panel, provides ready access to the Model 930A's case ground for safety purposes.



**RS-232C
REMOTE CONTROL/
PRINTER PORT**

MODEL 930A REAR PANEL
FIGURE 2-4

The RS-232C connector (Option 930A-10C), when present, is located at the lower right side of the rear panel. The connector is configured internally as Data Communication Equipment (DCE). This enables direct connection to Data Terminal Equipment (DTE) such as terminals or printers. However, connection to a MODEM (DCE) must be made through a "null modem" adapter cable.

CAUTION

The rear panel is held in place by four screws.
DO NOT REMOVE THEM
Access to the interior of the Model 930A is
provided by removing the top cover.

The top cover of the 930A case is secured by four 3/8 inch Phillips head screws. Removing these screws allows the cover to be lifted off, giving access to the interior. Figure 2-5 shows the interior of the Model 930A.

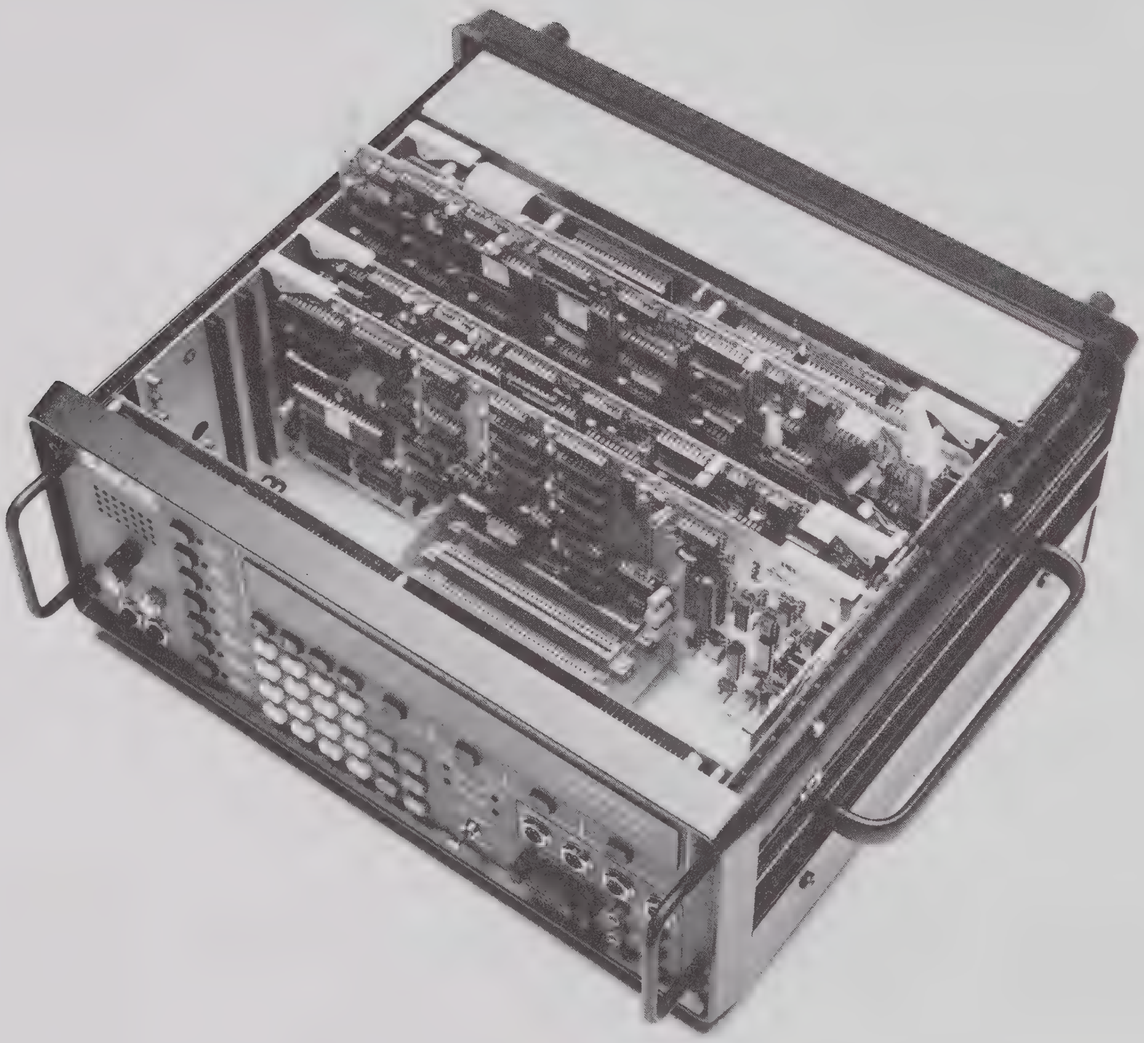
At the rear of the interior is a gold anodized box which contains the power supply.

WARNING

DO NOT ATTEMPT TO OPEN OR REMOVE THIS BOX
Doing so will expose the user to dangerous voltages.

The power supply is a 115 VAC line switching supply. It is intended for connection to standard U.S. line outlets and provides -48 V., ± 15 V., and +5 V. internally. If you should need 230 VAC, 50 Hz operation, call SAGE for instructions on converting the power supply.

There are seven PC Card slots inside the case. Some or all of these will be filled with cards depending upon options installed. The common cards for all units include: A CPU card, a Digital Signal Processing (DSP) card, an AC interface, and a DC interface card (Standard Analog access configuration). Other card slots are for options such as one, or two, PCM cards.



MODEL 930A INTERIOR VIEW
FIGURE 2-5

You may have occasion to remove a card from the Model 930A. Remove any attached cables from a card before attempting to remove the card.

WARNING

DO NOT REMOVE OR INSERT CARDS WHILE POWER IS ON

Cards are removed by means of the extractors built into each card. The small white plastic handles in each corner of the cards are the extractors. To remove a card, grasp the extractor handles and pull straight upward in an even motion.

When reinserting cards, they should enter their slots with an audible and tactile snap. Be sure that the cards are returned to the slot they came from and that all connecting cables to the cards have been correctly restored before applying power. Partially inserted boards will be damaged if power is applied.

The card edge contacts, and the edge connector itself, should be free from dirt, oxidation, or residues of any kind. If they are not, gentle cleaning with a special contact cleaning solution and a lint-free cloth may be necessary. Spray-on contact cleaners are available at most electronics stores.

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SECTION III
OPERATION

3-1 INTRODUCTION

This section of the manual provides you with information on the **operation** of the Model 930A **standard features.** These test primarily on analog communication networks. The Model 930A is a general purpose test set which has been designed to test Equal Access (Feature Group D), T-1, PBX, Data, Toll, Message, and Private Line trunks. The Model 930A is particularly well-suited to testing at the **DEMARC**, or Point of Interface (**POI**).

3-2 GETTING THE 930A TO DO WHAT YOU WANT

To begin, the 930A operates in a logical manner. The steps you need to follow are actually quite few. The operation always proceeds as follows:

1. Turn unit on.
2. Select Trunk Type, set direction (Office or Customer), set interface (2W 900 ohm, 4W 600 ohm, etc.), and select Terminated or Bridged operation, using softkeys.
3. Select desired test function such as Dial/Ring, Send Tone, Measure Noise, or optional function.
4. Use **HELP** and/or softkeys to set-up test functions if required.
5. Use front panel Hook Switch to seize the trunk, draw dial tone and hold the circuit up during test.
6. Use Numeric Keypad as required to dial out, etc.

You will find that the 930A retains the last settings you input so that it is only necessary to set functions up once in most cases. You will also learn later that every front panel setting can be stored in one of 39 memory locations for future recall.

For now, familiarize yourself with the locations of the front panel keys and press them to see what they do in various screens. In particular, see what the arrow keys and softkeys do. It Is probably a good idea not to connect the 930A to the actual trunk under test until after you are more familiar with its operation.

If you have the T-Carrier interface option installed in your 930A as most users do, you will find its operation covered in Section VI of this manual.

In the meantime, learn the functions of the various keys while in an analog trunk type such as **LOOP START** or **E&M.** Then the 930A won't keep beeping at you, and complaining that it doesn't have any **PCM**, when you haven't even connected it to a T-1. The display flashing has been slowed down in recent software versions and pressing any front panel key adds another 4 seconds to the interval between beeps so that you can set up the 930A in peace.

You can't hurt the 930A by pushing buttons, although we make no claims regarding what you may do to the trunk under test, and the traffic on it, through such actions. In many cases, precautions have been taken to prevent you from causing service interruptions through inadvertently pressing the wrong keys. The 930A either refuses to do what was asked and responds with a message, or simply does nothing.

Remember, the definition of a softkey changes with the display above it. They operate in several ways, but are at least consistent. That is, pressing a softkey will do one of the following things:

1. Nothing-The softkey you pressed is not active
2. Change to another displayed value (i.e., from **TERM** to **BRIDGE**)
3. Move the cursor or highlight over a parameter to be changed (i.e., pressing softkey under the level in the **SEND TONE** menu moves the flashing cursor from frequency to level so it can be changed).
4. Cause other parts of the display to change as well (i.e., changing from 2-wire to 4-wire mode on an analog trunk causes the 930A to go from Terminated to Bridged operation if it is not already there).

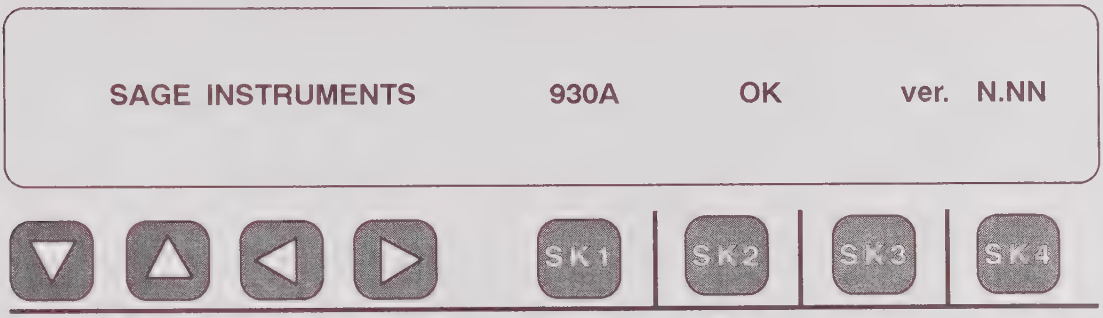
Pressing a softkey usually amounts to nothing more than scrolling through the available choices under the displayed heading. In most instances, you will be returned to where you started, if you press the key enough times.

Data entry on the Model 930A is accomplished in one of three ways: Numeric entry using the Numeric Keypad; Menu entry using the Softkeys; or incremental entry using the Cursor or Arrow Keys.

The rest of Section III is organized after the six steps outlined on page 3-1 and proceeds from the initial power-on stage, through the set-up, and use of the various standard tests, in the order in which they appear.

3-2.1 WHEN FIRST TURNING ON THE 930A

Once you have read Section II of this manual, you are prepared to turn on the Model 930A. When first switched on, the 930A will run through a PROM check and then briefly display the following:



where "N.NN" is the version of software present in the unit. Later you will learn how to find the software version without turning the unit off and on. Note the condition of the eleven LED's on the front panel. If a normal **"Warm Boot"** has occurred, one LED will be lit or flashing. If an error has been detected by the built-in self test, all of the LED's will be lit and the unit will perform a **"Cold-Boot."** This is an abnormal condition indicating a possible malfunction of the test set. Turn the 930A off and perform a **"Cold-Boot"** as described in Paragraph 3-2.2. Normally, the 930A will **"Warm-Boot"** and power-up to the last settings before it was turned off.

3-2.2 HOW TO "COLD-BOOT" THE 930A, OR WHAT TO DO IN CASE IT DOES NOT SEEM TO WORK PROPERLY

The first thing to realize about the 930A is that it reacts in many ways like a computer because, after all, it has an on-board processor. So, just like the big guys, it can occasionally lose its mind, wander off somewhere, act crazy, or be driven mad by its owner. **Cold booting the 930A** is similar to pressing CNTRL-ALT-DEL on an IBM PC. It gets the processors attention, clears out the memory, restores the factory defaults, and permits normal operation to resume. Think of it as the electronic equivalent of an Ex-Lax.

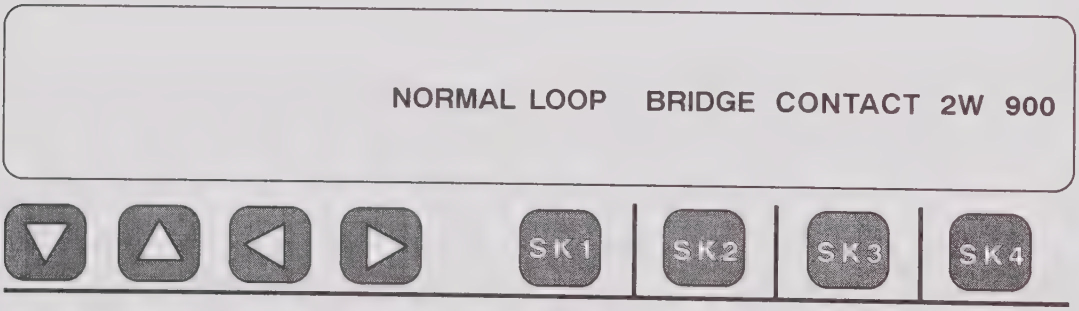
There are other times when this procedure is beneficial, aside from instances where the operation of the 930A is suspect. You may want to restore all the factory default settings if others have used your 930A and changed your settings. You may, from time to time, receive **FREE** software upgrades to your 930A. After installing the new EPROMs, it is necessary to perform a **cold boot** to initialize the software.

There are two types of "Cold-Boots" you can perform on the 930A. One is a complete **"hardware cold-boot"** and the other is a **"software cold-boot."** The latter has been added for the convenience of persons writing remote control software and can be found in Option Menu 92 which is discussed later. For now, concern yourself with how to do the hardware cold-boot. This is the type you will need to perform when changing software.

All that is necessary is to follow these steps:

1. Turn off the 930A
2. Hold down the **TRUNK TYPE** (or any other) Function key.
3. Keep the function key held down, turn on the 930A but do not release the function key until the display has scrolled all the way across the screen, and the 930A has started its PROM check.

A successful cold-boot will erase any previously stored settings, or test results, and restore factory defaults to all menus. The 930A will, after it completes its PROM test, come up in its default Trunk Type display which is shown below:



NOTE:
If you have purchased your 930A
without an analog interface (T-1 only),
then your default Trunk Type is PCM.

If the 930A does not come up to the default Trunk Type, then you did not get a cold-boot. Should you encounter any difficulty, please do not hesitate to call SAGE Customer Service at (408) 761-1000.

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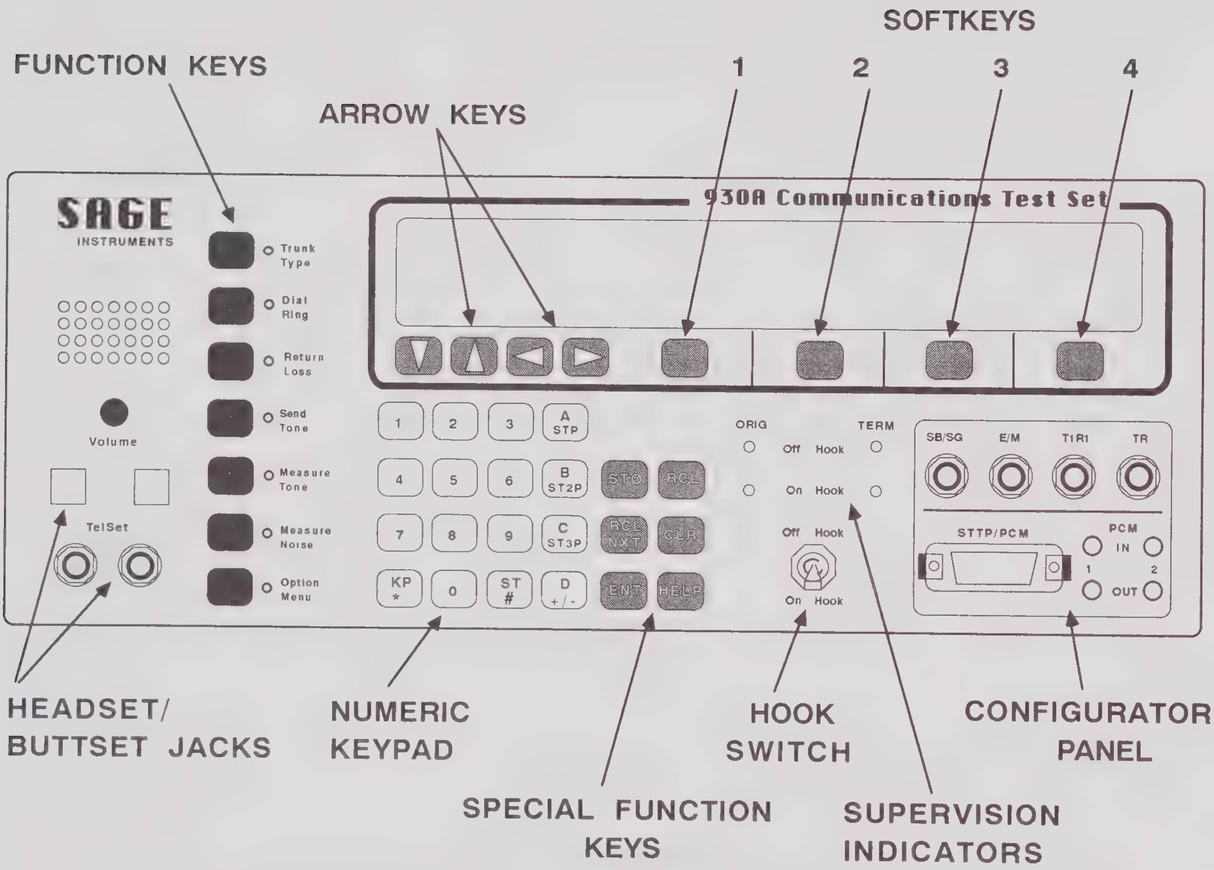


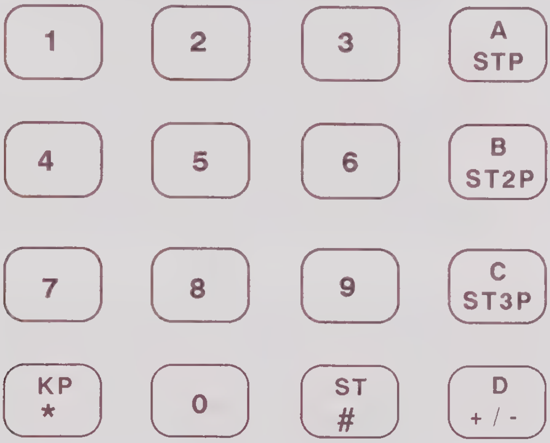
FRONT PANEL LAYOUT
FIGURE 3-1

3-3 FRONT PANEL CONTROLS, INDICATORS, AND CONNECTORS

The front panel layout with the locations of the controls, indicators, and connectors is shown in Figure 3-1. The descriptions start with the keypad and finish with the function keys because they take the most explanation.

3-3.1 HOW TO USE THE NUMERIC KEYPAD

The Numeric Keypad consists of the sixteen white keys located directly beneath the left hand corner of the display as shown in Figure 3-1 and in the enlarged diagram below. It is exactly the same as a telephone touch pad.



When entering numerical data such as Tone Frequency or Level, you will generally be prompted by a flashing cursor as to the digit location and number of digits expected by the 930A. Once the correct numerical values have been selected, you press either the **ENTER** key (See Section 3-3.2.5) or any of the softkeys. Any leading blanks (digits expected but not entered) are treated as zeroes. The sign of a number, such as tone level, may be changed by pressing the +/- key **before** you press **ENTER**.

AS LONG AS THE CURSOR IS DISPLAYED, NUMERICAL INPUT IS EXPECTED. The Model 930A will accept numeric data, or the +/- (change sign key), in this mode. Input may be terminated by pressing the **ENT** key, any softkey, or any function key. The following example shows you how to use the Numeric Keypad.

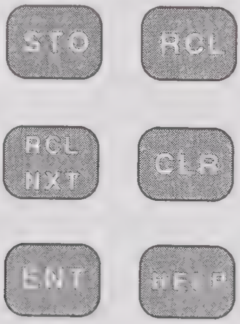
EXAMPLE:

> Press the **SEND TONE** function key. The most recent selection used will be displayed. A flashing cursor appears over the last digit of the frequency displayed. To change the frequency value, enter the desired number using the numeric keypad and then press the **ENTER** key. The new value will be displayed. Until the **ENTER** key is pressed, the digits may be changed and overwritten without affecting the tone being sent. The number displayed is only accepted when the **ENTER** key is pressed.

The main exception is placing a call in the **DIAL/RING** function, which will be explained later. In this case, **no cursor** is displayed. The **+/-** (also labeled "**D**") key sends the DTMF "**D**" tones instead of changing signs. Entry may be interrupted or terminated by the user at any time without pressing **ENTER**.

3-3.2 HOW TO USE THE SPECIAL FUNCTION KEYS

The six light grey keys, located to the right of the Numeric Keypad, are the **Special Function** keys. In many ways, the operation of the Model 930A is similar to that of a pocket calculator. This is nowhere more apparent than in the use of the **Special Function** keys. The keys, and a brief description of their functions, follows in subsections 3-3.2.1 to 3-3.2.6.



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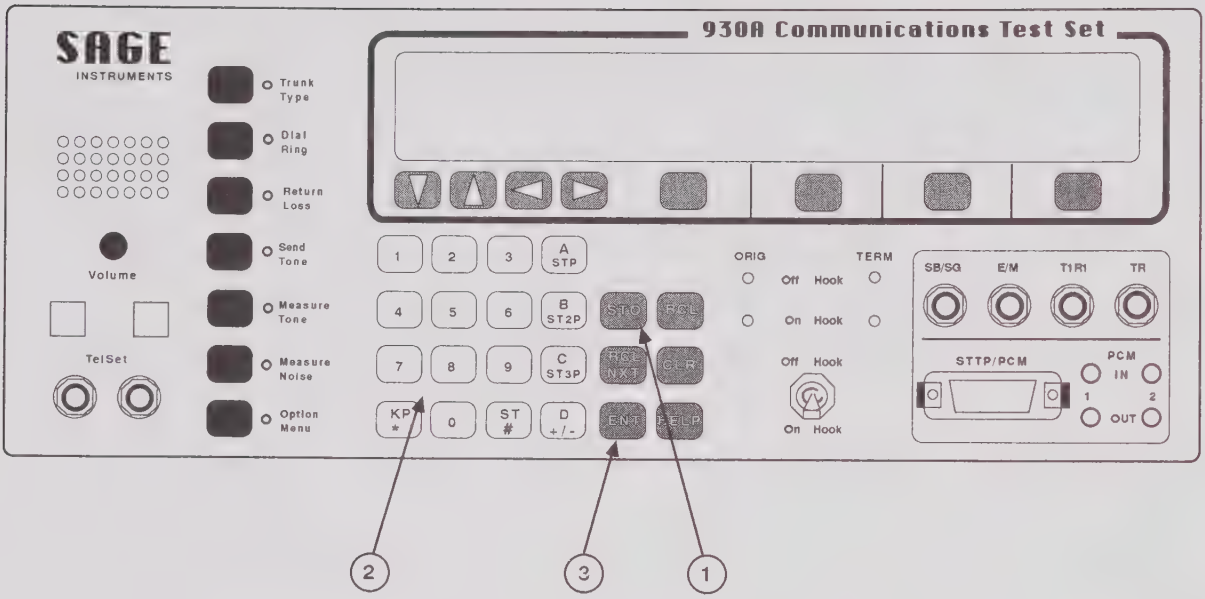
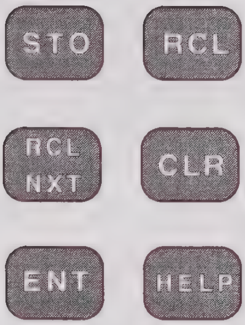


To Store a Test Set-Up, Menu Option, or Function in Memory:

1. Press the key labeled **STO** (Store).
2. Enter the number (00 to 39) of the memory location in which the "program" is to be stored.
3. Press the key labeled **ENT** (Enter) to complete storage exactly as you would do on a calculator.

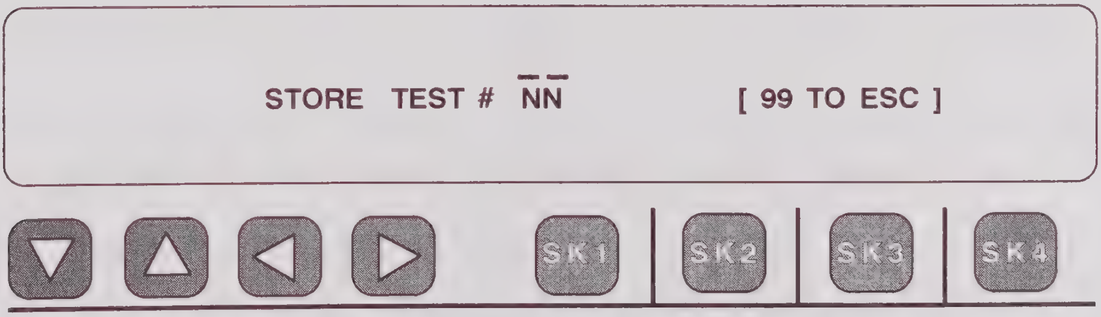
HOW TO STORE A SET-UP OR FUNCTION
FIGURE 3-2



3-3.2.1 HOW TO STORE SETTINGS AND TEST SET-UPS

The **STORE** key is used to store a particular test set-up, outpulse sequence, digit string, or any Option Menu such as **DIGIT RECEIVER,** into one of the forty register locations (00 to 39). This is done by pressing the **STO** key, entering the two-digit number corresponding to the register location desired, and then pressing the **ENTER** key. This function operates exactly like the pocket calculator function of the same name. After you have set up a particular parameter value (1004 Hz at 0.0 dBm level, for example), or test set-up (Digit Receiver/Analyzer set-up to receive **DTMF** digits on a **POTS** line), all you need to do is, press the **STO** key, enter the number of the location (00 to 39) where you want to store it, and then press **ENTER**. The 930A will retain what you have stored in its memory until the lithium battery on it's CPU runs down, or you overwrite that memory location with a new program, or you do a **cold-boot** which erases all memories.

The following display appears after the **STO** key is pressed:



```
STORE   TEST # NN          [ 99 TO ESC ]
```

" **NN** " in the display is the number of the storage location.

Refer to Figure 3-2 to locate the keys used when storing settings or set-ups.

3-3.2.2 DETAILS OF THE STORE FEATURE

All test memory locations are functionally identical so any location can be used. It is a good idea to use consecutive storage locations for related test set-ups. The Model 930A automatically increments the storage location after each entry. Press **STO** and **ENT** to store in consecutive memories.

Storing something new in a memory location automatically replaces the previous contents. A general description of the stored parameters for various test situations follows:

In Trunk Type: All of the trunk type parameters listed on the display are saved exactly as they are shown. For **PCM** trunks this includes the undisplayed parameters set in the sub-menu.

In Dial/Ring: The displayed digits, the outpulsing mode (**MF, DTMF, or DP**), **AND ANY MODIFICATIONS** made in **Modify Send Digits** (Option Menu 1) are saved. If a digit string has been stored with modifications (see Section 3-10.2), the outpulsing label (**MF**, **DTMF**, or **DP**) will be preceded by the ">" character.

In Return Loss: All of the displayed parameters, including signal type, echo-suppress tone, and trans-hybrid loss are saved.

In Send Tone: The level, frequency, and Tone On/Tone Off are saved.

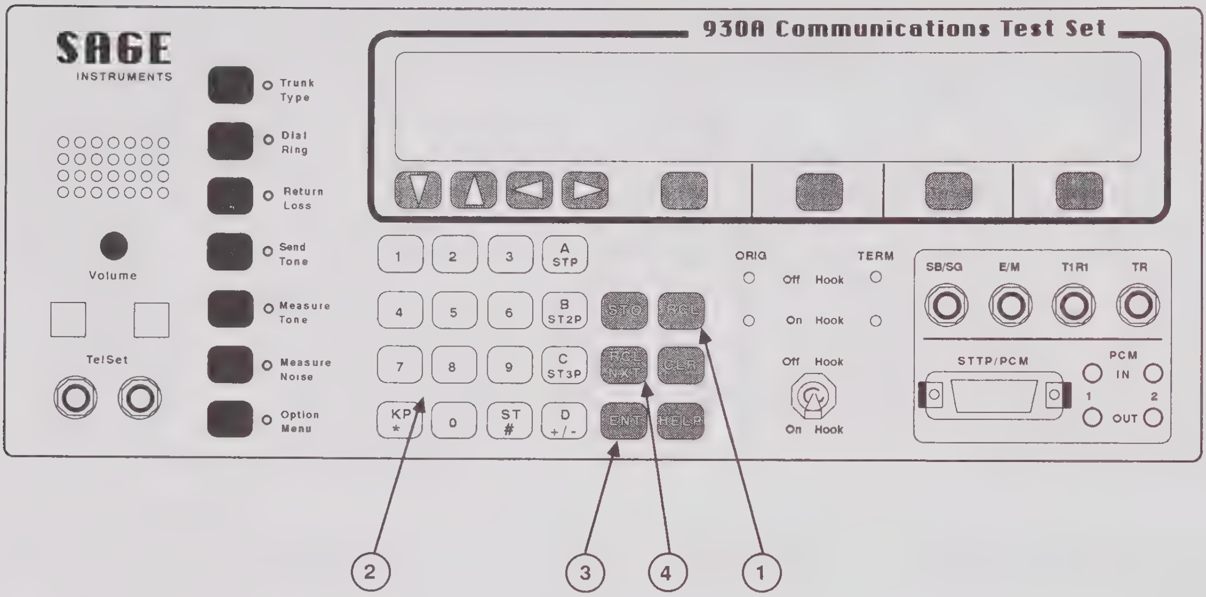
In Measure Tone: The relative zero level is saved.

In Measure Noise: The filter type, balanced or noise-to-ground measurement, and relative zero are saved.

NOTE: In any measurement function, it is the test set-up (parameters) which is saved, **NOT THE CURRENT MEASUREMENT RESULTS**.

To store a set-up from within an Option Menu, **EXIT TO THE OPTION MENU** by pressing the **OPTION MENU** key. All parameters of the menu selection (whose name and number are displayed) can then be saved using the **STO** key. The only exception to this is **Modify Dial/Ring** (Option Menu 1). Parameters set in **Modify Dial/Ring** are considered to be undisplayed parameters of the Dial/Ring Function and are saved with Dial/Ring.

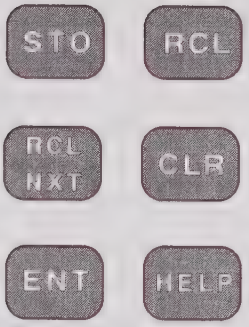
It is not possible to use **STORE** from within a **HELP** screen or sub-menu, nor is it necessary. All parameters set within a sub-menu, or **HELP** screen, can be saved with their parent function. Attempts to use **STORE** when it is not possible will produce no visible effect.



To recall a Test Set-Up, or Function, from Memory:

1. Press the key labeled **RCL** (Recall).
2. Enter the two digit number of the location in memory where the program is stored.
3. Press the key labeled **ENT** (Enter) to retrieve the program.
4. Press the key labeled **RCL NXT** (Recall Next) to recall the next program sequentially (i.e., Program 03, then 04, etc.)

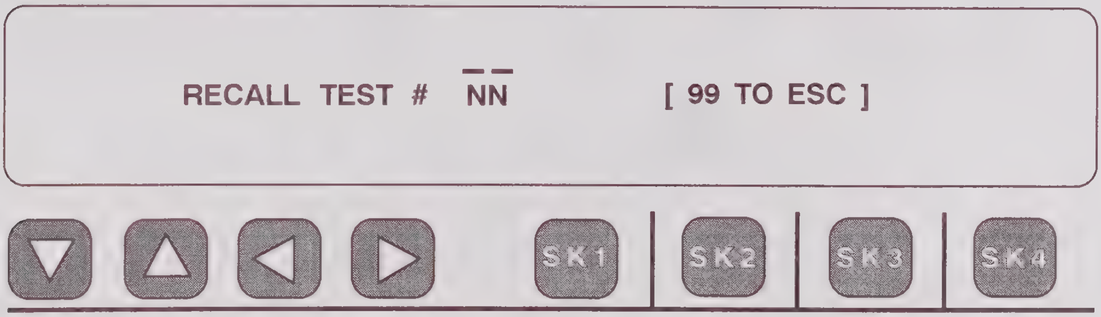
RECALLING WHAT HAS BEEN STORED
FIGURE 3-3



3-3.2.3 HOW TO RECALL WHAT YOU HAVE STORED

The **RECALL** key is used to recall a test set-up or other parameters which have been stored in a particular register. For example, if you had stored a **DTMF** sequence in the **DIAL/RING** function (4087611000, for example) in register 28. To recall the sequence, all you would have to do is press **RCL**, then enter a "**2**" and an "**8**" from the numeric keypad, and press **ENT**. Program 28 will then be recalled. You could be anywhere else, in any other menu, but when you tell the 930A to recall program 28, it will immediately take you back to **DIAL/RING.** The number 4087611000 will be there ready to send.

Pressing the **RCL** key will bring up the following display on the Model 930A:



RECALL TEST # $\overline{NN}$ [99 TO ESC]

Use the numeric keypad to input the number (between 00 and 39) of the storage location of the desired test set-up. Press **ENTER**, or a softkey, to recall the set-up stored in that location.

To exit without recalling a set-up, input "**99**" and press **ENTER**.

The **RECALL NEXT** key is a handy way for you to sequentially step through a number of programs you have stored in order. For example, let's say that you use the Gain Slope test tones a lot in your work. It would be nice to store the tones at the level you want to send them in three sequential registers. To do this you would go to the **SEND TONE** function and set the frequency to 404 Hz at say -10.0 dBm. Then you would store this as program 20, for example. Then you would change the frequency to 1004 Hz and store this as program 21. Next you would change the frequency to 2804 Hz and store this as program 22. Now, whenever you want to send the Gain/Slope tones, all you have to do is press **RCL**, enter the number **20**, press **ENT**, and send 404 Hz. Then press **RCL NXT** to bring up the 1004 Hz tone stored in location 21 and press **RCL NXT** again to bring up the 2804 Hz tone. You can expand on this simple example to do up to 40 things sequentially. All you have to do is recall the first item in the sequence. After that, all you have to do is push **RCL NXT**. Refer to Figure 3-3 for help in locating the keys used to recall stored programs and in using the **Recall Next** feature.

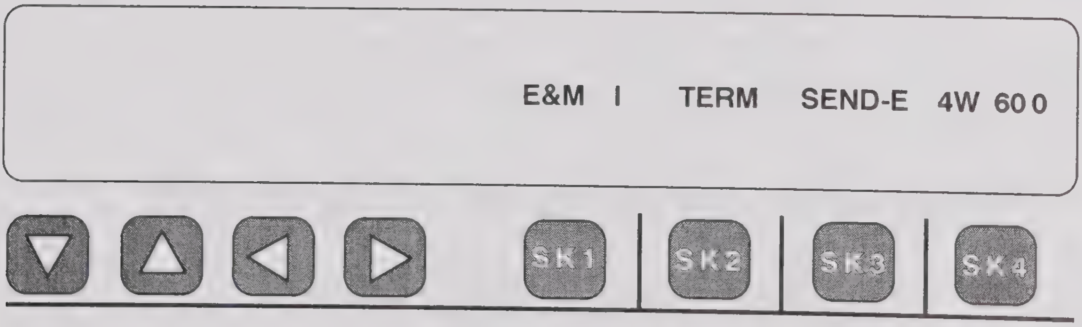
3-3.2.4 EXAMPLE OF STORING AND RECALLING

The following simple example will serve to illustrate the use of the **STORE**, **RECALL**, and **RECALL NEXT** keys:

EXAMPLE: One way to measure the loss on a line with the 930A is to perform the following steps:

Press the ○ **Trunk Type** function key.

The 930A display will appear somewhat like the following display depending upon the trunk type selected:



```
E&M I    TERM    SEND-E   4W 600
```

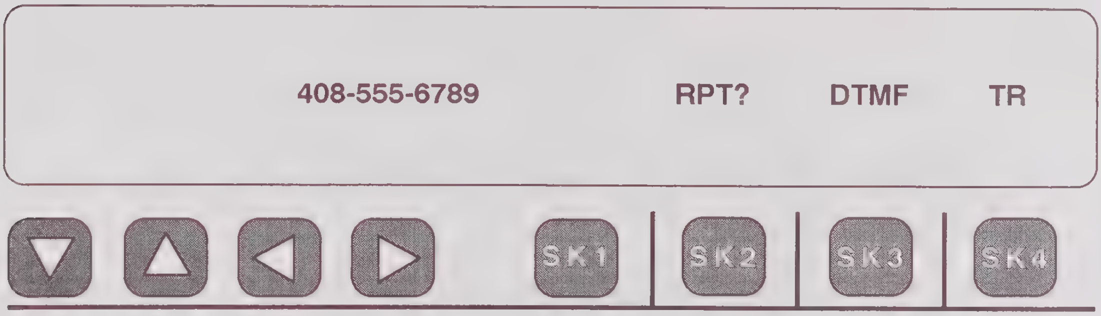
Set up the Trunk Type to the correct condition (assume that the above displayed trunk type information is correct for this example) and store it in register location 1.

Press the STORE **STO** key, then press **1** and then **ENT**

Press the DIAL/RING ○ Dial/Ring function key.

Go Off Hook by placing the Hook Switch in the **OFF HOOK** position and, using the keypad, enter the telephone number of the local milliwatt test line. The 930A will dial the number as it is entered.

An example 930A display follows:



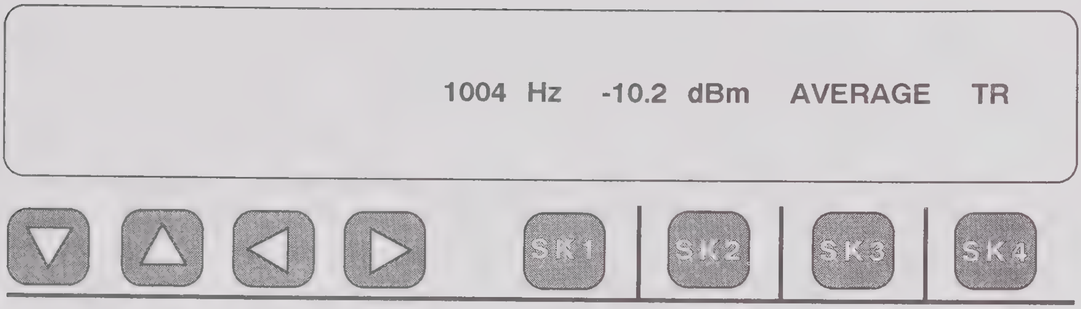
408-555-6789 RPT? DTMF TR

Store the test line phone number in register location 2.

Press the STORE **STO** key and then the ENTER **ENT** key.

Press the Measure Tone ○ Measure Tone function key.

Measure the level being sent when the tone is audible.
A typical 930A display is shown on the following page.



Store the **Measure Tone** Function set up in register location 3.

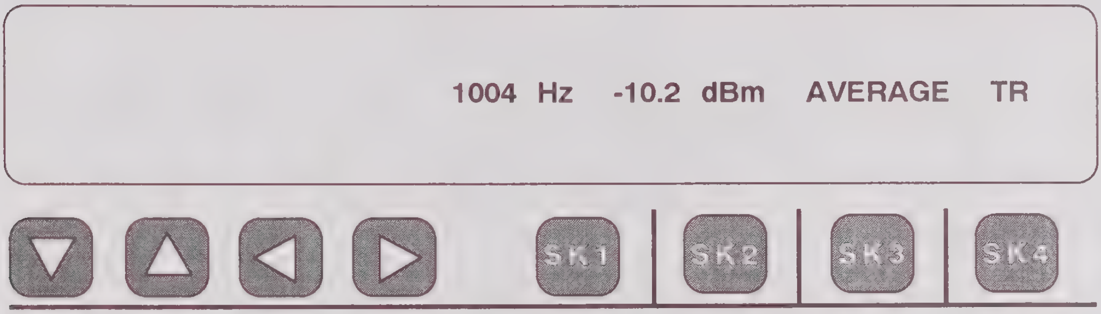
Press the STORE **STO** key and then the ENTER **ENT** key.

The test has now been performed and the test sequence has also been stored. The entire test can now be rerun at any time with only six simple keystrokes as shown on the next page.

To rerun the test sequence in the previous example follow the steps below (Go **OFF HOOK** after step 3).

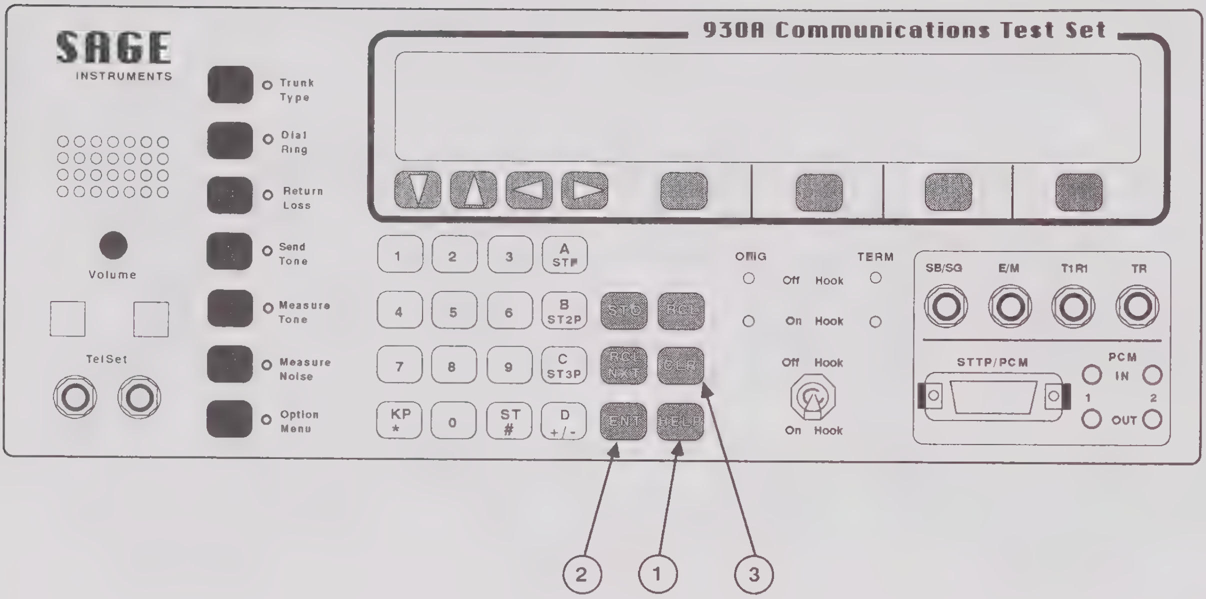
STEPS	PRESS KEY	DESCRIPTION
1	RCL	
2	1	
3	ENT	Recalls Trunk Type Set-Up
4	RCL NXT	Recalls Milliwatt Number
5	SOFT KEY 2	Places the Call
6	RCL NXT	Calls Up Measure Tone

The displayed measurement is the loss on the line. A typical display of measured tone would appear somewhat like that shown below:



1004 Hz -10.2 dBm AVERAGE TR

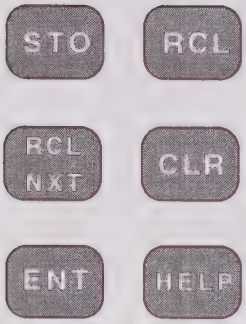
Remember that in order to outpulse the phone number, the 930A Hook Switch must be placed in the **OFF HOOK** position to seize the line and draw dial tone. Then pressing Softkey 2 (under **RPT?**) will outpulse the digit string.



To use the **HELP**, **ENTER** or **CLEAR** keys:

1. Press the key labeled **HELP** for step by step instructions of set-up procedures for any of the function keys except the Option Menu key. The set-up selections are made using the **softkeys** under the display.
2. Press the key labeled **ENT** (Enter) to complete a numeric entry.
3. Press the key labeled **CLR** (Clear) to clear out or initialize a sequence as in **DIAL/RING** mode. It does **NOT** clear numeric values to zero.

USING THE HELP, ENTER, AND CLEAR KEYS
FIGURE 3-4



3-3.2.5 HOW TO ENTER AND CLEAR DATA

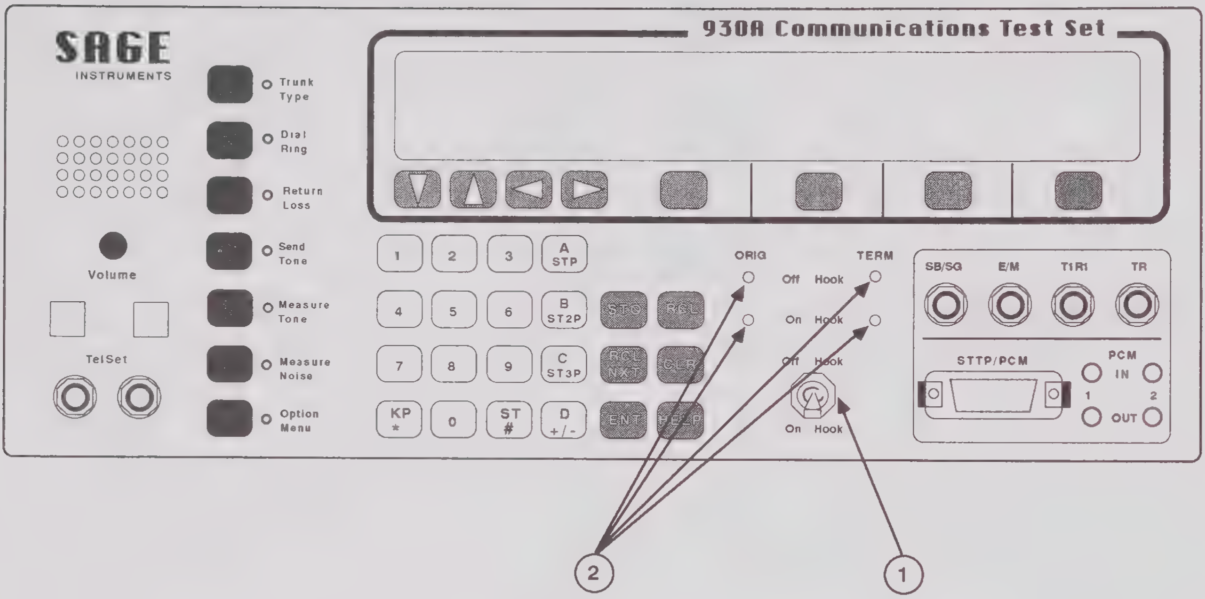
The **ENTER** key operates exactly like a calculator functions. Once the correct numeric data has been input for a particular test or program, all you do is press **ENT** and the data is accepted. In some cases, you cannot advance to the next operation until you have completed your data entry by pressing the **ENTER** key. Pressing **ENTER** will also cause a print out of the current display if a printer is connected to the 930A in Printer remote mode.

The **CLEAR** key is used to clear or initialize sequences and allow new entries to be made. It is **not** used to clear a numeric value to zero. This is done by simply entering a zero. The **CLR** key is used to clear sequences of variable length, such as a string of digits to be outpulsed in the **DIAL/RING** mode.

The only functions which require the use of the **CLEAR** key, and which are covered in this manual, are Dial/Ring (Section 3-5), Send Digit Sequences (Section 3-10.3), Digit Receiver (Section 4-2) and DS-0/DS-1 Errors (Sections 6-6, 6-17 and 6-18).

3-3.2.6 HOW TO USE THE HELP KEY

The **HELP** key is provided to assist you in operating the Model 930A. Any time you get stuck, pressing the **HELP** key provides a series of screens which generally lead you, step-by-step, through the function. **Remember** that when you press the **HELP** key, the **softkeys** are controlling each selection. So, as each screen appears, you must choose the correct parameter for your test by pressing the **softkey** directly under the displayed value, or item, you want. **HELP** is available in each function from **TRUNK TYPE** down to **MEASURE NOISE**. **HELP** is **not** available for the individual functions under the **OPTION MENU** function key. This is due to the large number of functions under this key and the limitations on memory.



To use the Hook Switch:

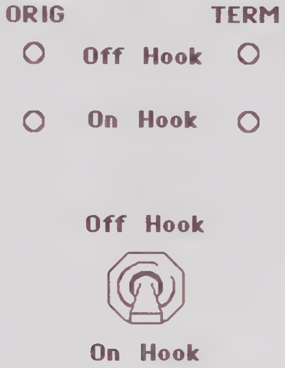
1. The Hook Switch controls whether the 930A is **"On Hook"** or **"Off Hook."** On 2- and 4-wire analog trunks it also engages the holding coils. (To outpulse digits, send tones, etc., the 930A must be **Off Hook** in most cases.)*
2. The Supervision LEDs show the status of the Originate and Terminate ends of the circuit.

* In some Trunk Types and directions (such as Loop Contact), the 930A must be **"Off Hook"** to send tones and outpulse digits.

HOW TO USE THE HOOK SWITCH
FIGURE 3-5

3-3.3 USING THE HOOK SWITCH TO SEIZE AND RELEASE TRUNKS

The chrome switch located to the right of the Special Function keys, as shown in Figure 3-5, is the **Hook Switch**. The four LED's above the Hook Switch are the Supervision Lamps.



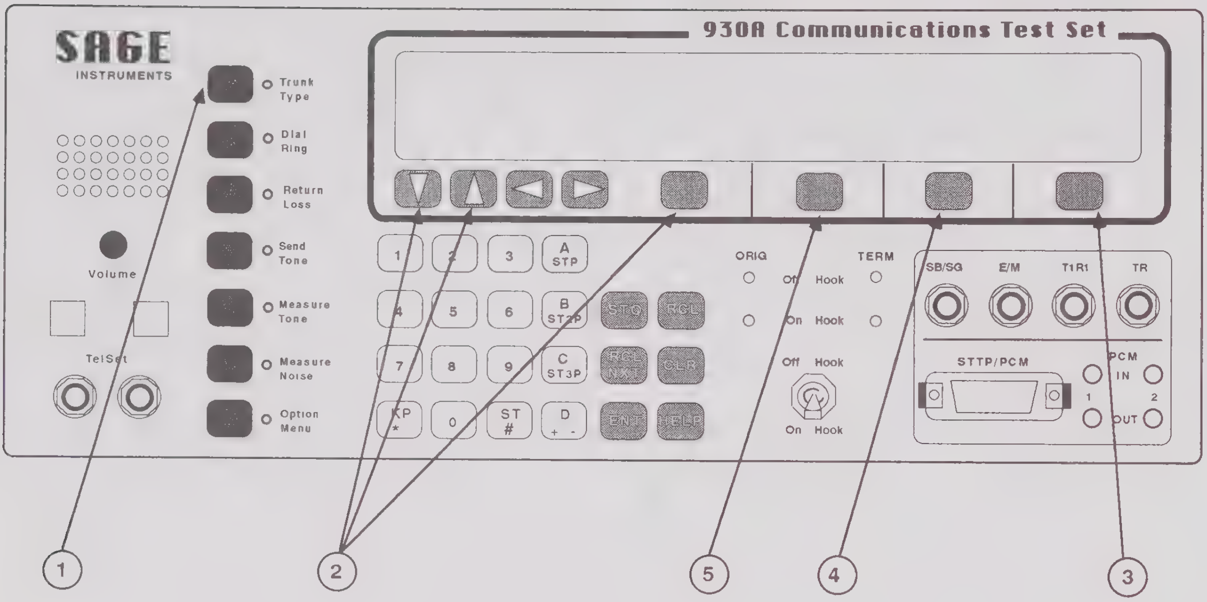
A WORD ABOUT SUPERVISION

The Supervision Lamps are labeled "**ORIG**" and "**TERM.**" The 930A is obviously the "**Originating**" end of the circuit when sending digits. The 930A is the "**Terminating**" end when receiving digits. In certain applications it is less obvious which end is "**Originating**" and which is "**Terminating.**" An example of this might be Foreign Exchange circuits. By convention, then, the "**ORIG**" lamp always shows the 930A status, unless it is receiving digits.

The Hook Switch is labeled "**ON HOOK**" and "**OFF HOOK.**" In order to send a string of digits it is necessary to go "**OFF HOOK.**" This is identical to the procedure employed when placing a regular telephone call. The telephone handset must first be picked up (going **Off Hook**) before the number can be dialed. Going "**ON HOOK**" is the same as hanging up the telephone and terminating the call. The Hook Switch on the 930A performs the same function as the **"HOLD"** button on other TMS test sets. When "**OFF HOOK**" the Hold Coils are engaged, or the 930A supplies **BATTERY** , depending on direction.

NOTE: If the 930A has been placed in a **REMOTE CONTROL** mode, the Hook Switch is inoperative unless **STANDBY** mode is selected (Section 5-1.1).

The operation of the Hook Switch on **PCM** trunks is described in Section VI.



To Select and Set-Up Metallic (Analog) Trunk Types:

1. Press the **TRUNK TYPE** function key.
2. Use the **UP/DOWN** arrow keys or Softkey 1 to scroll through and select the desired trunk type.
3. Press Softkey 4 to select 2-wire or 4-wire operation and the appropriate impedance (150, 600, 900 or 1200 ohms)
4. Press Softkey 3 to select the correct simulation for the testing direction (**BATTERY** to simulate the Central Office toward the subscriber loop, **CONTACT** to simulate the subscriber toward the Central Office, **SEND-M** to be the Originate office or **SEND-E** to be the Terminate office).
5. Press Softkey 2 to select **TERM**inated or **BRIDGE**d operation as appropriate.

HOW TO SET-UP ANALOG TRUNK TYPES
FIGURE 3-6

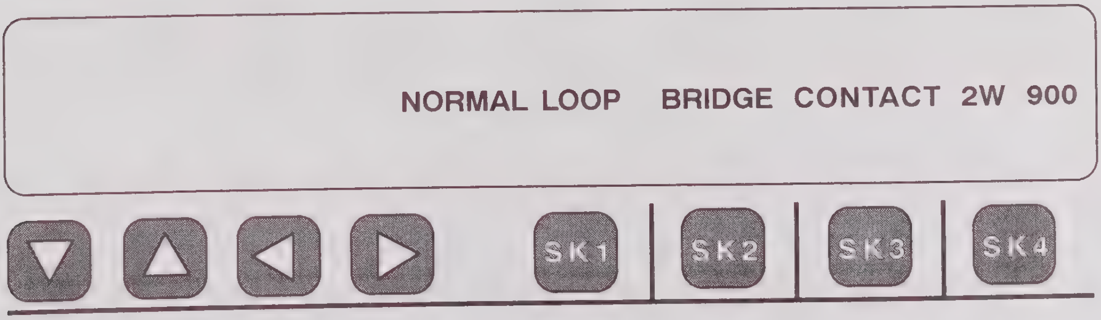
3-4 HOW TO SELECT THE TRUNK TYPE

The 930A is not capable of deciding, on its own, what type of trunk it should set itself to in order to test. It has to depend upon you, the user, to know what kind of a trunk you are testing. To this end, the following information may be helpful.

3-4.1 TYPES OF TRUNKS AND WHERE YOU FIND THEM

You are familiar with **POTS** or **P**lain **O**ld **T**elephone **S**ervice such as you have in your home. In most instances, this is a 2-wire Loop Start trunk of 900 ohms impedance. In your office, you may be served from a PBX. These may use either 2-wire Loop or 2-wire Ground Start trunks to connect to its subscribers. The impedance may be 600 or 900 ohms. These trunks generally use either Dial Pulse (**DP**) or Touch-Tone (**DTMF**) digits to place calls.

If you are testing trunks between Central Offices, from a PBX to a Central Office, or from Interconnect Carrier to local telephone company, you will be testing 4-wire trunks in general. These trunks may be **E&M Type I** (**Types II** and **III** are used in electronic switch offices), **SF** (getting rarer as time goes on), or **T-Carrier PCM** which is now the dominant interoffice facility. The analog trunks present a 600 ohm impedance while T-1 is a nominal 100 ohms. The type of signaling usually found on interoffice trunks is Multi-Frequency (**MF**) because that is how the switching machines talk to each other. It is also possible to see **DP**, **DTMF** or combinations of **MF** and **DTMF**. T-Carrier now goes out to customer premises and into residential areas (**SLC-96**) as well. You need to know the type of trunk you are testing on, its impedance if possible, and the type of signaling it has on it before starting to test. Pressing the **TRUNK TYPE** key will cause the 930A to display the current Trunk Type and configuration in use. A typical display is shown below:

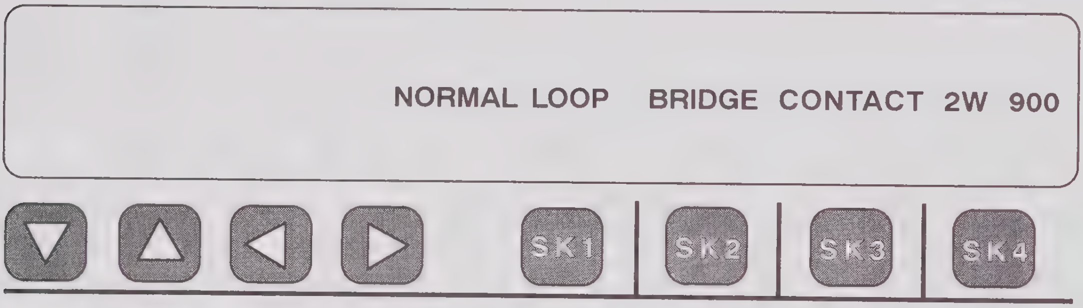


```
NORMAL LOOP   BRIDGE  CONTACT  2W  900
```

When power is first applied to the 930A it will default to the **Trunk Type** function. Refer to Figure 3-6 for step-by-step set-up procedures for the standard analog (**Loop Start, Ground Start and E&M**) trunk types.

3-4.2 HOW TO SET-UP A TRUNK TYPE ON THE 930A

Pressing the **TRUNK TYPE** function key will produce a display somewhat similar to the example below depending upon the **Trunk Type** previously selected. Each type has a similar display.

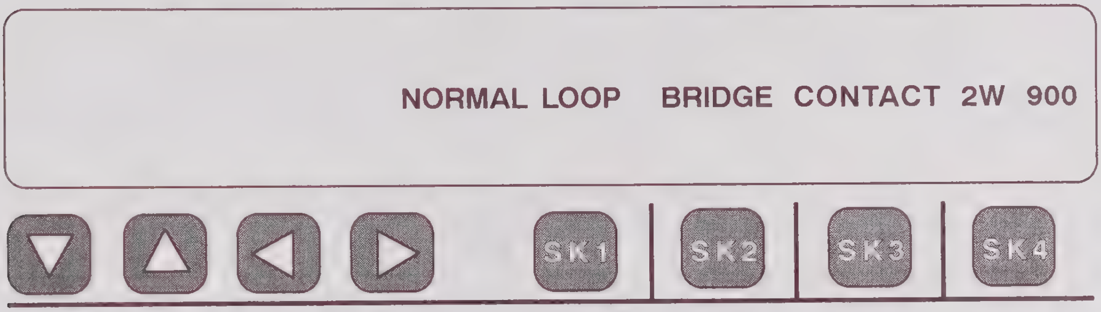


The softkeys have been labeled as **SK1** through **SK4** in the examples in this manual. They are blank on the actual 930A front panel.

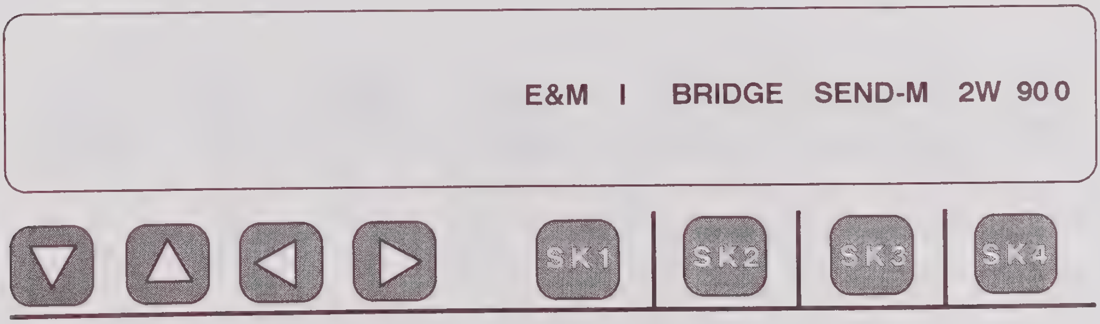
This may not be the trunk that you want. You will have to change it to what you do want. Suppose that you need to test an **E&M** type trunk. The operation of the arrow keys and softkeys necessary to accomplish this is described in the following example. The procedure applies to any of the standard trunks.

3-4.2.1 EXAMPLE: SETTING UP AN E&M TRUNK

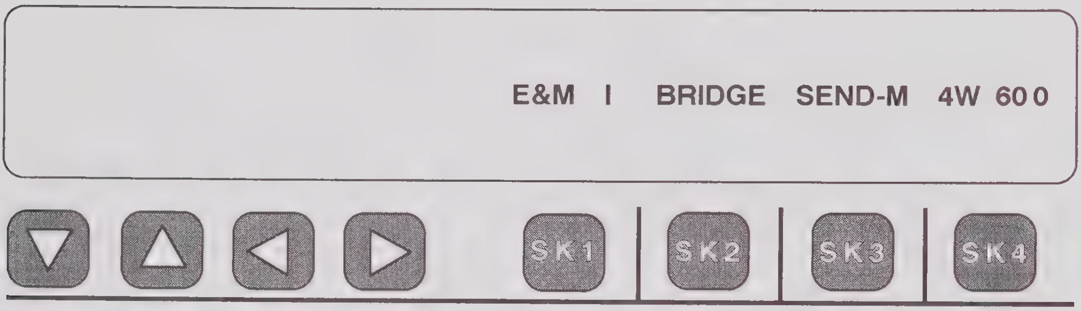
We want to terminate a 4-wire **E&M Type 1** trunk for this example. Suppose that the **TRUNK TYPE** function key has been pressed and we are starting from the **Loop Start** trunk displayed on the previous page. The first thing to do is find the **E&M** trunk types. **The easy way** would be to press the **HELP** key and follow the prompts. For example purposes, we will go through it the hard way, starting from the following display.



Press either the **UP** or **DOWN** Arrow keys, or Softkey 1 (**SK1**), and this will page you through the various Trunk Types. Let's say we use the **UP** Arrow key and scroll from Loop Start through Ground Start and then to **E&M.** When you get to the **E&M** trunks the display below will appear. This is because this example started from the 2-wire Loop trunk shown above.



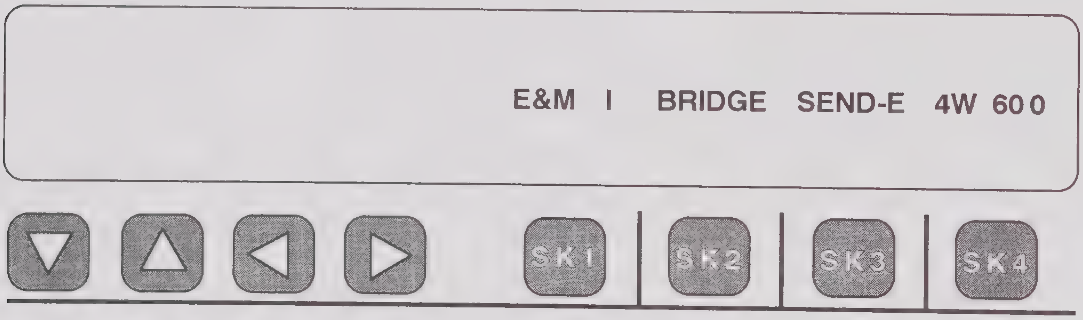
This is not yet what is wanted because this example is supposed to be a 4-wire mode. To change the trunk and impedance, press Softkey 4 (**SK4**) to page through the various combinations until you get to the **4W 600** ohm display which is the most common impedance for **4-wire E&M**. Now the 930A display looks like the one on the following page.



```
E&M  I   BRIDGE   SEND-M   4W 600
```

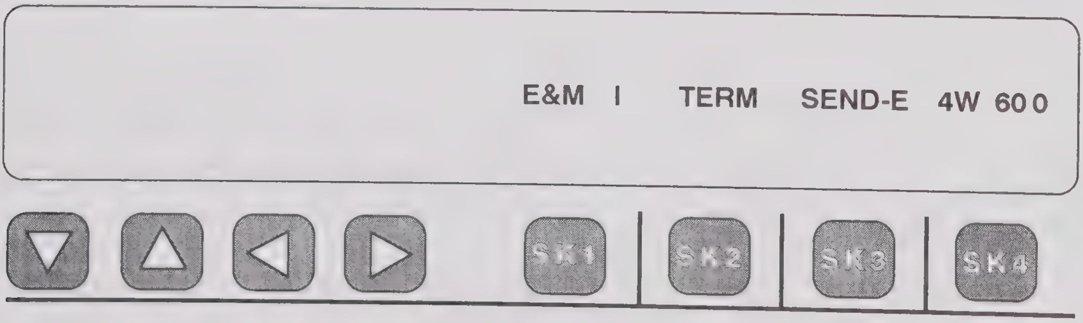
Next, you have to determine whether to send supervision on the **M** Lead or the **E** lead. To simulate the **originating** end of the circuit, we need to send on the **M** lead. To simulate the **terminating** end of the circuit, we must send on the **E** lead.

If you do not know, then guess. The state of the LEDs above the Hook switch will tell you if you are wrong. That is, when you are terminating the trunk and the switch is **ON HOOK**, both LEDs should be lit in their **On-Hook** positions. If not, then change your direction from **Send-M** to **Send-E**, or vice versa. If you know, for example, that you want to send on the **E** lead, press Softkey 3 and the display above will change to:

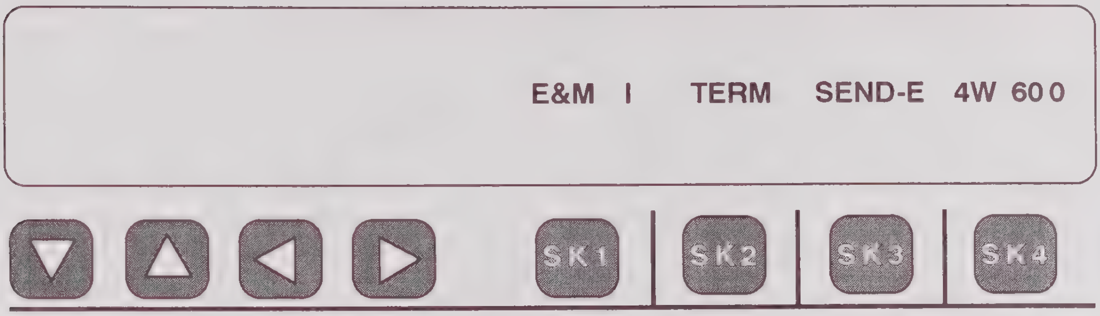


```
E&M  I   BRIDGE   SEND-E   4W 600
```

To terminate the circuit, change from Bridge to Terminate mode by pressing Softkey 2 which changes the display to:



```
E&M  I   TERM   SEND-E   4W 600
```



The 930A is now ready to terminate a **4-wire E&M Type I** trunk and send supervision on the **E** lead. The same basic procedure applies to any of the analog trunk types which are standard in the 930A.

The following details apply only to operation of the 930A front panel keys in the **TRUNK TYPE** function, and only for analog trunks.

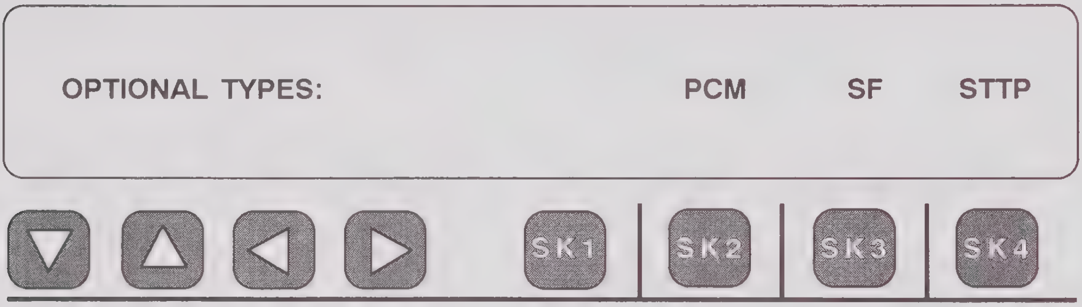
1. The Numeric Keypad is inactive
2. The **LEFT/RIGHT** Arrow keys are inactive
3. The **UP/DOWN** Arrow keys roll through the available trunk types
4. Softkey 1 is a wheel selecting Trunk Type. It has the same effect as the **UP** arrow key.
5. Softkey 2 toggles between Bridge and Terminate. When Terminated, the 930A simulates one end of a circuit. In Bridge mode, the 930A passively monitors the circuit.
6. Softkey 3 is a wheel selecting which end of the circuit the 930A simulates in the Terminate mode. In Loop or Ground Start this may be either **CONTACT** (a telephone or PBX) or **BATTERY** (Central Office). In **E&M**, this may be either **Send-E** or **Send-M**, indicating which lead the 930A is using to send supervision.
7. Softkey 4 is a wheel selecting 2- or 4-wire circuits and 150, 600, 900, or 1200 ohm impedances.

NOTE:

Changing trunk types or changing from 2W to 4W operation automatically places the 930A in the **BRIDGE** mode. In the Bridge mode, the 930A does not send supervision. The Supervision Lamp marked "**ORIG**" shows the end of the circuit which the 930A would simulate if it were in "**TERM**" mode.

3-4.3 WHERE TO FIND OPTIONAL TRUNK TYPES

There are several options which can be purchased for the 930A to expand its capabilities. These include testing T-1 (**DS-1 PCM**) carrier trunks, trunks employing **SF** supervision, or interfacing directly with the Secondary Trunk Test Panel (**STTP**) used with the No. 1/1A ESS. Pressing the **TRUNK TYPE** Function key will display the current trunk type. Use the **UP/DOWN** arrow keys, or Softkey 1, to page through the available trunk types until the Model 930A's display is:



If an option has not been installed in the 930A, attempts to select it by pressing the softkey below it will cause the Model 930A to flash a **"NOT INSTALLED"** message on the display. If any or all of these options have been purchased, then pressing the softkey located beneath the displayed optional trunk type will cause it to be selected.

A detailed description of the operation of optional trunk type functions is contained in Sections IV and VI.

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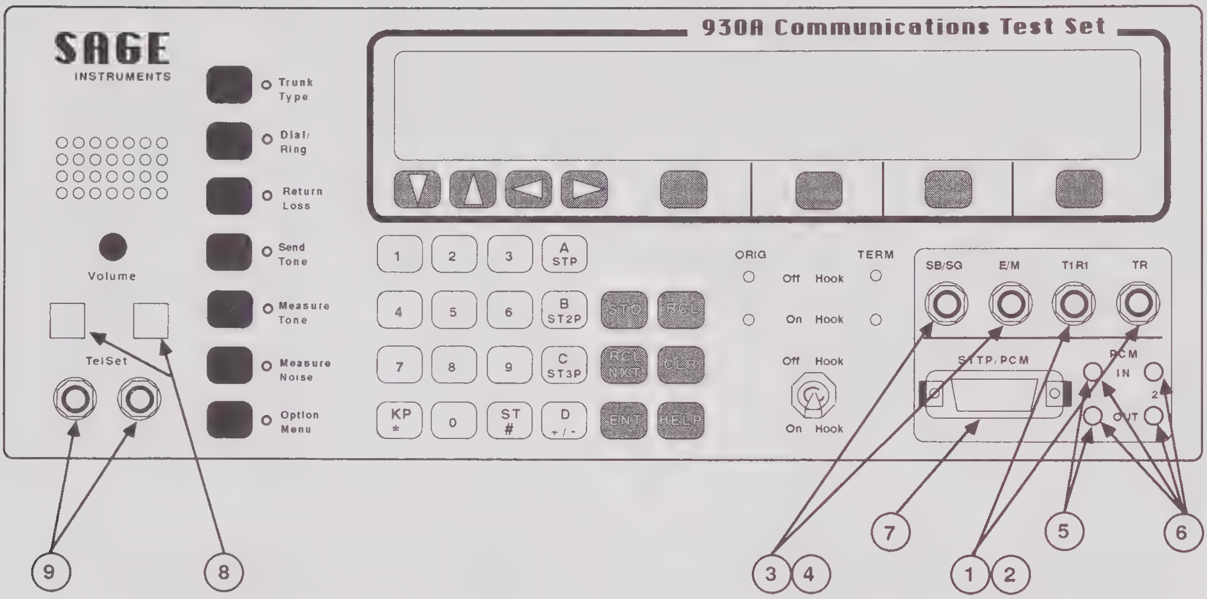


Test Cord connections to the 930A:

1. 2-wire metallic access uses the type 310 jack labeled "**TR**".
2. 4-wire trunks use the 310 jacks labeled "**TR**" and "**T1R1**".
3. **E&M Type I** trunks use the 310 jack labeled "**E/M**" as well as the **TR** and **T1R1** jacks.
4. **E&M Types II, III and IV** use the **SB/SG** jack as well as the other three jacks.
5. Single direction T-1 testing uses the **PCM IN 1** and **OUT 1** jacks.
6. Dual direction T-1 testing uses **PCM IN 1** and **2** and **PCM OUT 1** and **2** .
7. The 15 pin connector is used with Options 930A-14 and 930A-114 to provide a direct interface to a No. 1/1A ESS machine.
8. Connect Lineman's Butt-Set to the Butt-In connectors.
9. Connect Telephone Headset or Handset to the Tel-Set jacks.

CONNECTION OF TEST CORDS
FIGURE 3-7

3-4.4 HOW TO CONNECT TEST CORDS TO THE 930A

Figure 3-7 shows the connection points for the various test cords which may be used with the 930A. The universal configurator is shown because it has the most varied connections.

Several types of configurator panels are available depending upon the options installed in the 930A. Refer back to Figure 2-3, page 2-6 for a description. Although the jacks may be located in different positions, a jack labeled **"TR"** or **"PCM IN 1"** for example, is connected and used the same on all configurator panels.

A 2-wire Loop Start, Ground Start, or Reverse Battery trunk is connected to the 930A at the type 310 jack labeled **"TR"**.

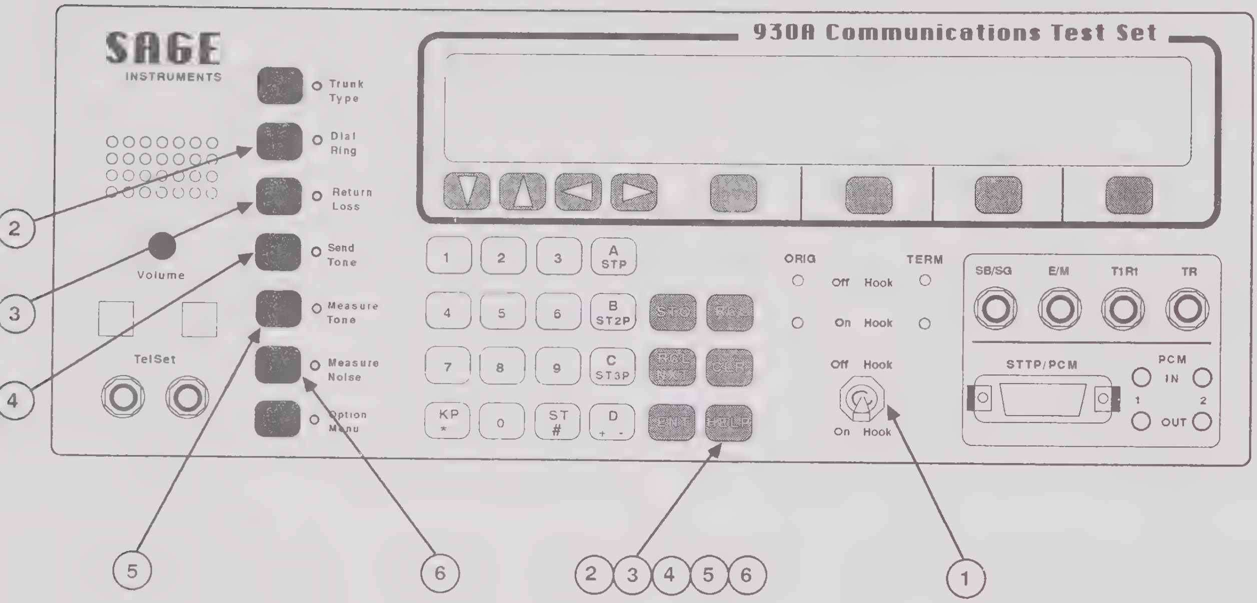
A 4-wire trunk requires connections to the type 310 jacks labeled **"TR"** and **"T1R1"**. If the trunk is an **E&M** trunk, the **E&M** lead test cord must be connected to the type 310 jack labeled **"E/M"** for Type I. If **E&M Types II** through **IV** are being tested, the signal battery/signal ground leads must be connected to the type 310 jack labeled **"SB/SG"**.

If a T-1 (DS-1) carrier circuit is to be tested, the tiny telephone (bantam) jacks labeled **"PCM IN 1"** and **"PCM OUT 1"** are used for single direction testing (Option 930A-08E). **For dual direction drop and insert** testing, **"PCM IN 2"** and **"PCM OUT 2"** will also be used. This requires Option 930A-09E to be installed. The **310 A/P** configurator uses type 310 jacks instead of bantam jacks, but the function is the same.

PCM trunk testing diagrams are shown in Section VI, Figures 6-2 through 6-12.

If the 930A is to be used to directly interface to a No. 1/1A ESS switching machine at the local trunk test panel, then the Sage Model 114A adapter must be wired into the trunk test panel. The 930A is connected to the 114A by a special cable using the 15 pin connector labeled **"STTP/PCM"**.

To place a call using the 930A, or to talk over the trunk under test, a telephone handset, or lineman's butt-in set, can be connected to the Tel-Set jacks, or the butt-in terminals, located in the lower left hand corner of the front panel.



Some commonly performed tests are:

1. After selecting the correct trunk type, place the **Hook Switch** in the **OFF HOOK** position to draw Dial Tone.
2. To place a call, press the **DIAL/RING** Function key. Press the **HELP** key if unsure of operation.
3. To measure Return Loss, press the **RETURN LOSS** Function key. Press the **HELP** key if unsure of operation.
4. To send a frequency at a specific level, press the **SEND TONE** Function key. Press **HELP** if unsure of operation.
5. To measure the frequency and level of a received tone, press the **MEASURE TONE** Function key.
6. To measure the noise level on a circuit, press the **MEASURE NOISE** Function key. Press the **HELP** key if unsure of operation.

COMMONLY PERFORMED TESTS
FIGURE 3-8

3-4.5 HOW TO FIND AND USE THE 930A's BASIC TEST FUNCTIONS

The six basic test functions built into all Model 930A's are controlled by the seven black keys arranged in a column along the left edge of the front panel of the Model 930A as shown in Figure 3-8. There is one key for each of the six basic test functions, and an "Option Menu" key for additional functions and future expansion of capabilities. The six basic test functions and the sections in which they are covered are:

○ Trunk Type	(Section 3-4)
○ Dial/ Ring	(Section 3-5)
○ Return Loss	(Section 3-6)
○ Send Tone	(Section 3-7)
○ Measure Tone	(Section 3-8)
○ Measure Noise	(Section 3-9)

Seventeen additional functions are standard with the Model 930A.

○ Option Menu	(Section 3-10)

Some of these additional functions are: Modify Send Digits, Send Digit Sequences, DC Volt/Amp Meter, Supervision Threshold Adjustment, Supervision Monitor, Wink Timing, Frequency Sweep, Adjust TLP, Beep On Error, Dial-Up Testline, and Dial-Up Sweep. These functions are described in detail in Section 3-10.

The operation of purchased options is covered in Sections IV, V and VI. A guide to locating specific test options is found on pages 4-3 and 4-4.

The Model 930A operates basically the same way in each trunk type and test function, whether it is a standard or optional feature.

The following sections attempt to lead you in an orderly manner from selecting the Trunk Type, to placing a call, to making the basic telephone measurements such as level, frequency, noise and return loss which are standard features. The more complex measurements, and trunks such as T-1, which are purchased options for the 930A, are described in Sections IV, V and VI.

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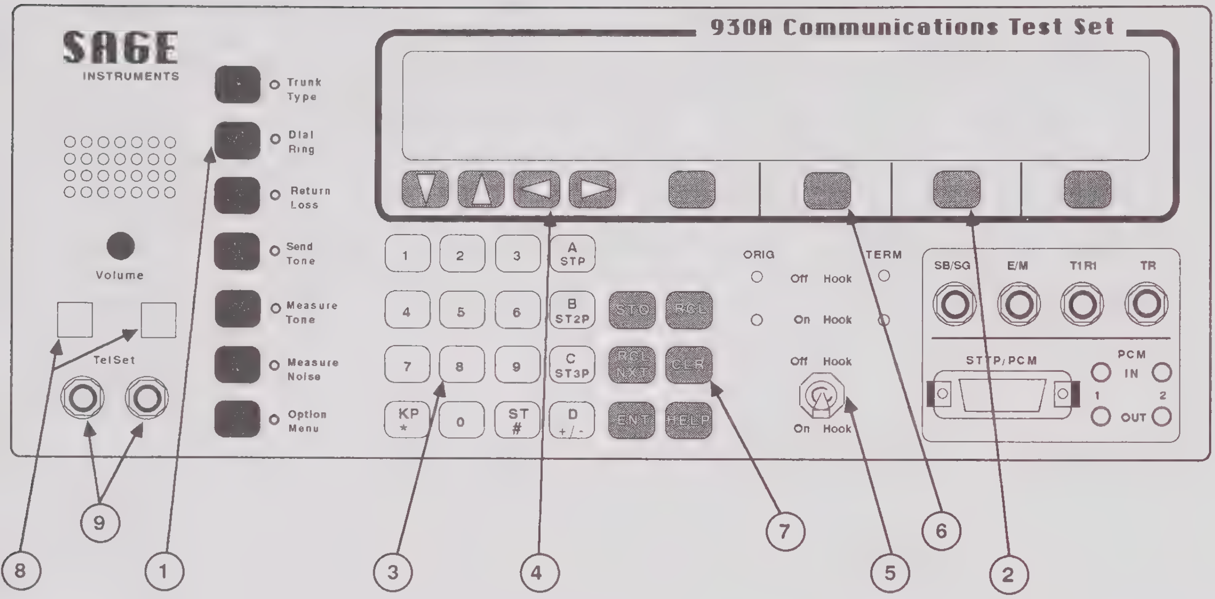


To enter a telephone number and place a call:

1. Press the **DIAL/RING** function key.
2. Press Softkey 3 to select **MF**, **DTMF**, or **DP**, as appropriate.
3. Enter the number of the telephone being called using the numeric keypad.
4. If a 1 second pause is desired (to get an outside line at a PBX), press the **LEFT** Arrow key after the digit has been entered (i.e., 9-4087611000).
5. Place the Hook Switch in the **OFF HOOK** position.
6. Press Softkey 2 (under **RPT?**) to outpulse the digit string.
7. Press the **CLR** (Clear) key to clear out a sequence before entering a new one.

NOTE: DIGITS ARE OUTPULSED AS THEY ARE ENTERED IF THE 930A IS OFF HOOK

8. To talk over the trunk under test using a Lineman's Butt-In set, connect it to the terminals shown.
9. If a Central Office headset or handset is available, connect it to the Tel-Set jacks to talk over the trunk under test.

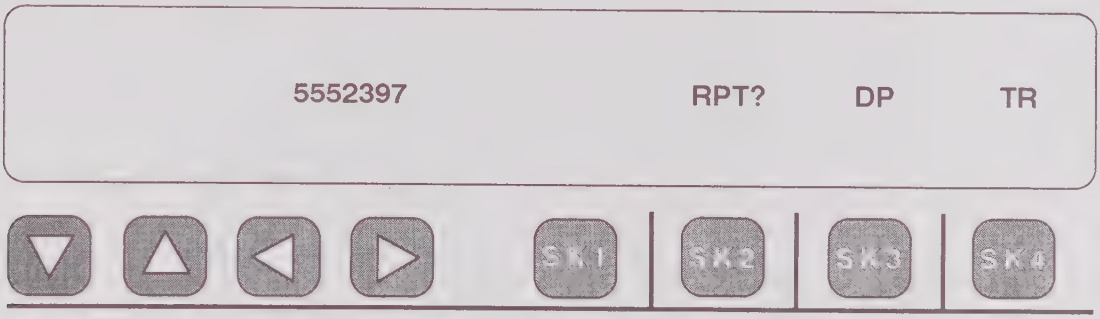
PLACING A CALL
FIGURE 3-9

3-5 HOW TO PLACE A CALL USING THE DIAL/RING FUNCTION

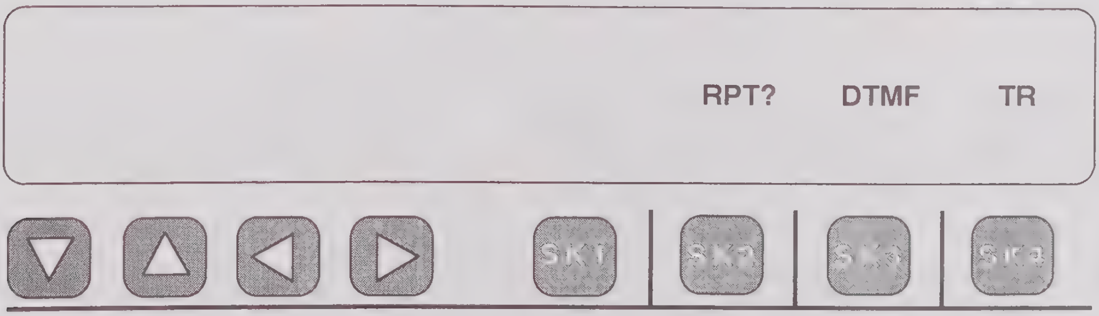
Once you have selected and set-up the correct **TRUNK TYPE**, as outlined in Section 3-4, you may want to place a call, and either talk on the trunk, or get a tone back from the local milliwatt generator.

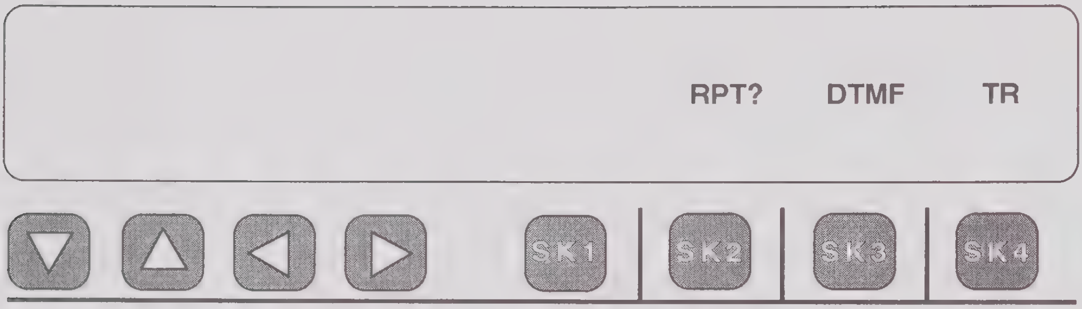
You must know the number you want to call, but more importantly, you must know whether the digits will be outpulsed as **MF, DTMF** or **DP**. If you want to talk on the trunk, you will also need a lineman's Butt-In Set or a Tel-Set such as the type used at Central Office test panels.

To begin, the front panel Hook Switch should be **On-Hook**. Then, locate the **DIAL/RING** function key shown in Figure 3-9 and press it. The last entered mode and sequence will be displayed.



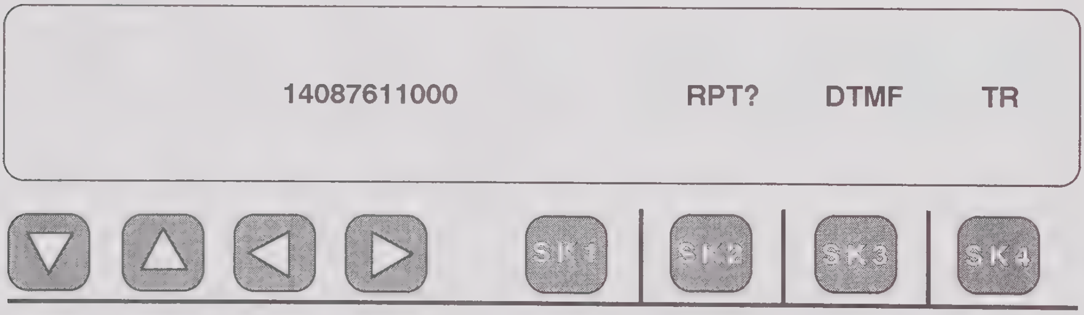
Since this is probably not the number, or even the type of call, you want to place now, you must set the display for the type of call you do want to make. As an example, you may want to place a Touch-Tone (**DTMF**) call to the number (408)761-1000, and have to dial a 1 first. **The first step** is to select **DTMF**. Again, the easy way is to press the **HELP** key and let it step you through using the softkeys. But you can simply press Softkey 3 (under **DP**) until **DTMF** appears. Notice that this also clears the old number. The display looks like the one below when you have it set correctly:





Now you are ready to enter the number. You can either go **OFF HOOK** first, using the front panel Hook Switch, in which case the digits are outpulsed as you dial, or you can enter the digits first and then go **OFF HOOK**. You would then press Softkey 2 (under **RPT?**) to have the 930A send the digits.

Enter the digits using the keypad like a regular telephone set. The **LEFT** Arrow key enters a 1 second pause. The display will look like the one below when you have entered the call sequence.



This mode and sequence can be stored for future use if it is a frequently dialed number. Use the **STORE** function to place it in any one of 40 register locations.

Remember: When you are going to send **MF** digits you must first enter a **KP** (Key Pulse), then the numbers, and finally, end the string with an **ST** (Stop Pulse). For example, an **MF** digit string could be **KP00415555 1212ST**.

Refer to Section 4-7 for directions in how to use the optional **RING GENERATOR**, if you have purchased that option.

Details on how to modify the level, frequency, and timing of the digits being sent are contained in Section 3-10.2.

3-5.1 DETAILS OF DIAL/RING OPERATION

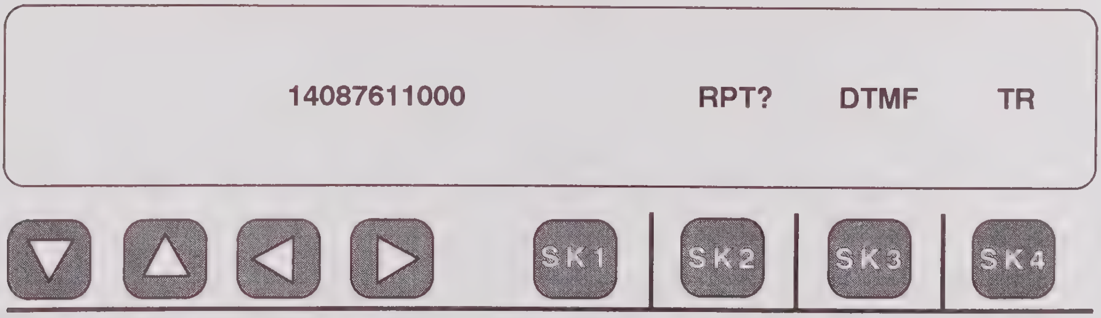
The functions of the various front panel keys, when the 930A is in the **DIAL/RING** mode, are outlined below:

The Left Arrow ◁ key is used to insert a one second pause into a digit sequence and appears on the display as a "-" between digits as in "9-14087611000".

Softkey 1 is inactive unless the 930A is in the **RING** mode (Option 930A-13 has been installed).

Softkey 2, labeled "**RPT?**", is asking the question, "Do you want to repeat the previously outpulsed digit sequence?" Pressing this key will outpulse the digit sequence currently displayed.

Softkey 3 is a wheel and is used to select either Dial Pulse (**DP**), Multifrequency (**MF**), Dual-Tone Multi-frequency (**DTMF**) or **RING** (Refer to Section 4-7 for details of the **RING** mode operation). Dial Pulse is not available when the 930A is simulating a CO (Supplying **BATTERY**). Changing the outpulsing mode will clear the display of any digit sequence.

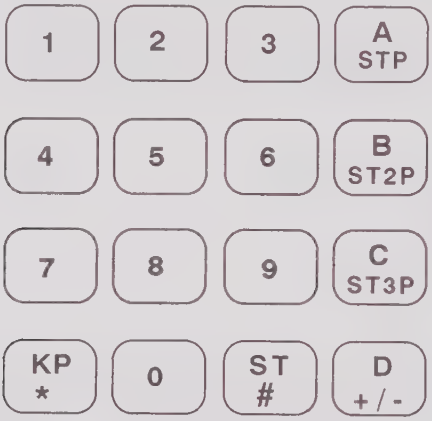


Softkey 4 is inactive. In the display above, it indicates which leads are in use for outpulsing (**TR, T1R1, Send-E, Send-M, PCM 1 or PCM 2**).

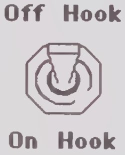
The Clear CLR key clears the display and erases any "remembered" digits.

The Enter ENT key is inactive.

The Numeric Keypad (including the ABCD keys) is the "dialer" and is used to enter digits.



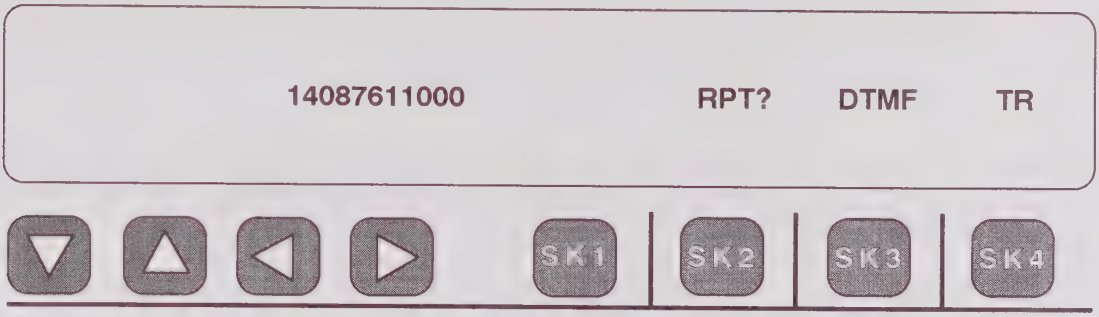
If the Hook Switch is in the OFF HOOK position, then the digits will be outpulsed as they are entered.



3-5.2 HOW TO STORE AND RECALL PHONE NUMBERS

You can easily store frequently used phone numbers for future recall and outpulsing. Pressing the **STO** (Store) key allows you to save the currently displayed digit sequence, its outpulsing mode (**MF, DTMF, or DP**), and any modifications which may have been made using **MODIFY DIAL/RING** (Option Menu 1). The parameters may be stored in any one of the 40 register locations (numbered from 00 to 39).

For example, suppose you want to store the unmodified **DTMF** sequence, shown in the following display, in register location 17.



To store this number in register location 17, you do the following:

1. Press the STORE STO key.

2. Press 1 and then 7 .

3. Press the ENTER ENT key.

The procedure is the same for storing any phone number in any register location. Simply enter the desired two-digit memory location in place of the 17 used above.

To recall the digit sequence, simply press the RECALL RCL key, then press 1 and 7 then press the ENTER ENT key.

A REMINDER

The recalled digit sequence will set the outpulsed parameters to the values that were set when the digits were stored. Always check for the ">" prompt when recalling digits. Any modifications are available for inspection in **MODIFY DIAL/RING** (Menu Option 1).

Information on storing and recalling Multi-Wink sequences, such as those found in Equal Access, TSPS, and IDDD applications, is contained in Section 3-10.3.

NOTE:

For IDDD applications in which a CCITT No. 5 **MF** sequence is being outpulsed, the required **KP2** pulse is equivalent to the **ST2P** pulse located on the **B** key on the 930A numeric keypad. Such an **IDDD MF** sequence would appear as:

ST2P11071738945ST

3-5.3 TRANSMISSION LEVEL POINT (TLP) COMPENSATION

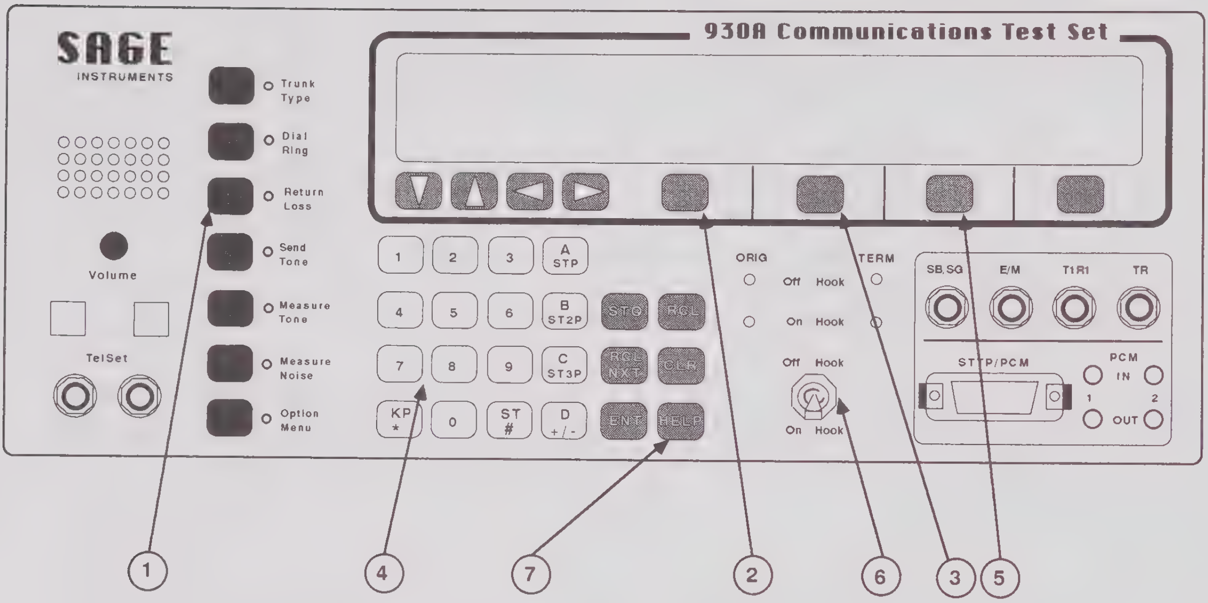
Sometimes it is necessary to adjust the TLP of the 930A when sending or receiving digit strings, or when talking or listening on the trunk under test.

The 930A default TLP settings normally take care of this automatically when the Trunk Type is selected. However, in cases where the TLP on the trunk under test is not close to the default TLP settings, or the levels are too "hot," you will get invalid received levels for incoming dialed digits and the audio volume will be off as well.

In this case, the 930A lets you manually set the TLP level of the transmit and/or receive section to compensate. **Adjusting the Receive TLP** of the 930A has the effect of making the 930A digit receiver either more, or less, sensitive as required.

Changing the Transmit TLP affects the level of the dialed digits being sent by the 930A. Digits outpulsed from the 930A are normally sent at 7 dBm per tone below the Transmit TLP (i.e., at a 0 dB TLP the 930A sends individual **MF** and **DTMF** tones at -7.0 dBm, at a -16 dB TLP the 930A sends the tones at -23 dBm).

A detailed discussion of the TLP adjustment is contained in Section 3-10.10. The Adjust TLP function is contained in Menu Option 30.



To Measure Return Loss:

1. Press the **RETURN LOSS** Function key.
2. Press Softkey 1 to select **ERL, SRL-LO, SRL-HI,** or Sinewave Return Loss measurement.
3. Press Softkey 2 to send the momentary Echo Suppressor disable tone (2125 Hz) prior to testing.
4. Use the numeric keypad to enter any other disable tone (2000 to 2250 Hz range), or to enter tones for Sinewave (**OSC**) Return Loss.
5. Press Softkey 3, if required, to measure and enter the Trans-Hybrid Loss correction.
6. Ensure that the 930A is **OFF HOOK** when measuring Return Loss.
7. Press the **HELP** key if unsure of operation or set-up procedure.

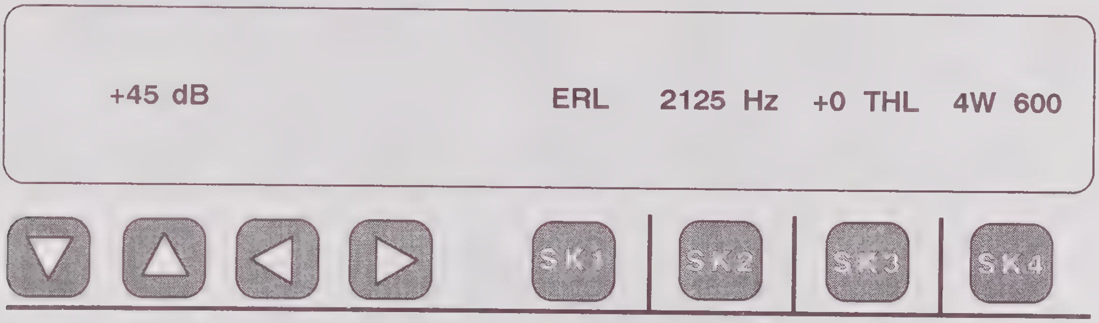
MEASURING RETURN LOSS
FIGURE 3-10

3-6 HOW TO MEASURE RETURN LOSS WITH THE 930A

Once you have set the 930A to the correct Trunk Type, it is relatively easy to measure Return Loss. Generally speaking, on an actual trunk, you would dial up a "Quiet Termination" at the distant end first, and then proceed to measure the Return Loss. We will assume that all this has been done. Refer to Figure 3-10 for step-by-step instructions in how to measure Return Loss.

In most instances, you will be measuring Return Loss on a 4-wire trunk, although the 930A is also capable of measuring on 2-wire trunks as well.

Press the **RETURN LOSS** function key and the 930A will immediately enter the Return Loss measuring mode. A typical example of a Return Loss display is shown below:



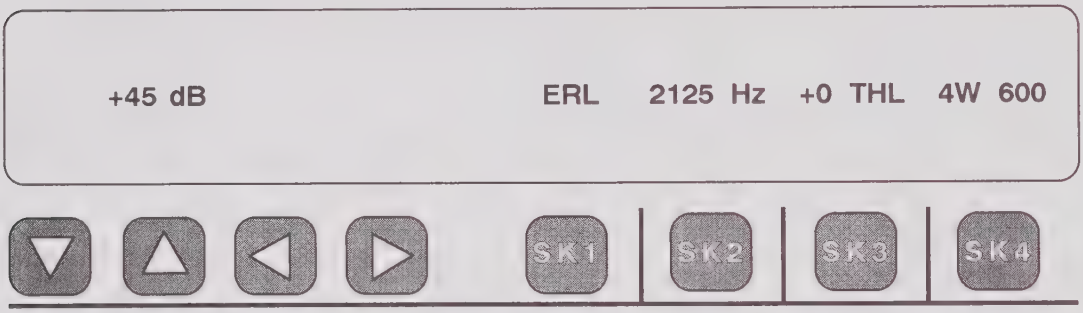
The 930A comes up with the pattern it was last sending in this mode which in this example is the Echo Return Loss (**ERL**) pattern. It could have been Singing Return Loss High (**SRL-HI**), or Singing Return Loss Low (**SRL-LO**), or Sinewave (Oscillator) Return Loss. **Pressing Softkey 1** will page through the different patterns.

The reading you get will not be valid unless echo suppressors/cancellers, which may be present on long distance circuits, are disabled. To do this, press Softkey 2 (under **2125 Hz**) and the 930A will send out the echo suppressor disable tone momentarily. It is a good idea to send the disable tone prior to any Return Loss measurement unless you are absolutely sure that no suppressors are in the circuit.

Measuring and correcting for Trans-Hybrid Loss is a bit more complicated to explain but is easy to do with the 930A and is covered in Section 3-6.2.

3-6.1 DETAILS OF KEY OPERATION IN RETURN LOSS

The Model 930A is capable of Echo Return Loss (**ERL**), Singing Low (**SRL-LO**), Singing High (**SRL-HI**), and Oscillator or Structural (**OSC**) Return Loss measurements on both 2-wire and 4-wire circuits. Once the **RETURN LOSS** key has been pressed, the 930A will begin to send the selected Return Loss signal, and receive and display measurements. A typical display is shown below to help explain the key functions.



The operation of the front panel keys during Return Loss measurement are as follows:

> Softkey 1 operates like a wheel. You select the Return Loss pattern (ERL, SRL-LO, SRL-HI, or OSC), or the type of TR Termination (2-wire only). The patterns are sent at an average level of 10 dB below the TLP.

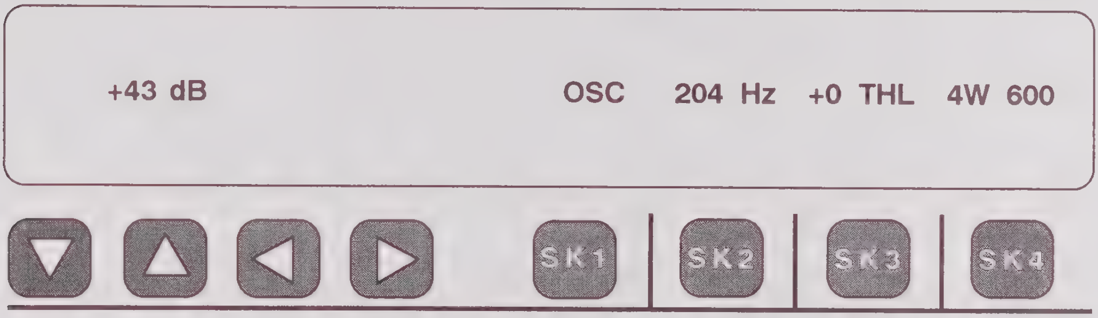
IN ERL, SRL-LO AND SRL-HI:

> Softkey 2 sends the echo-suppress tone displayed above it. A common frequency is 2125 Hz, but you should verify the correct value. Use the numeric keypad to enter the desired value of echo-suppress tone. Usually any value between 2000 Hz and 2250 Hz will work.

Softkey 3 is inactive in a 2-wire application. In a 4-wire circuit, this key selects Trans-Hybrid Loss (**THL**) as a parameter to be changed. This will be described later in Section 3-6.2.

Softkey 4 is inactive. The circuit and impedance are displayed above it. These values are set in the Trunk Type function discussed in Section 3-4.

IN OSC (OSCILLATOR OR STRUCTURAL) MODE:

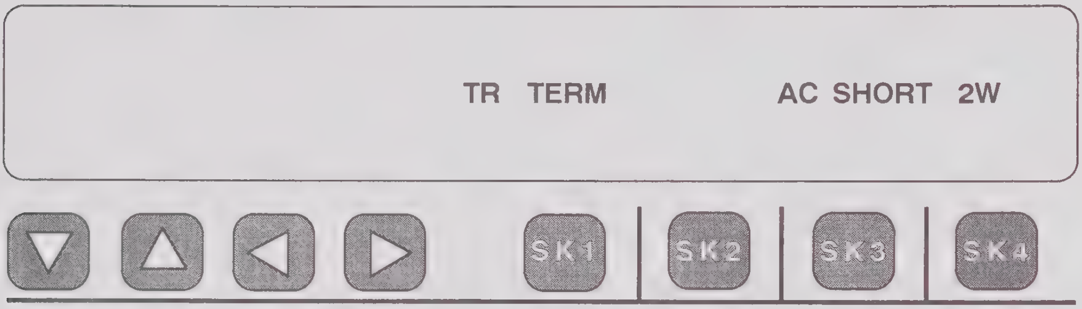


Input from the Numeric Keypad modifies the frequency of the tone being sent. Any desired frequency between 20 Hz and 5000 Hz may be entered. The tone is displayed above Softkey 2. The tone is sent at 0 dBm below the **TLP** level.

Softkeys 2 and 4 are inactive.

Softkey 3 affects the **THL** in the same manner discussed above.

IN TR TERMINATION (2-WIRE CIRCUITS ONLY):


TR TERM AC SHORT 2W

Softkey 2 is inactive.

Softkey 3 operates like a wheel which lets you select the type of termination (AC SHORT, AC OPEN, 600 ohm w/2.16 ufd, or 900 ohm w/ 2.16 ufd).

Softkey 4 is inactive.

NOTE: TR Termination is available only if the 930A is in a 2-wire mode as selected in **TRUNK TYPE**.

3-6.2 TRANS-HYBRID LOSS AND HOW TO MEASURE IT

Trans-Hybrid Loss is exactly what its name implies: It is the loss across a 2-wire to 4-wire Hybrid. A Hybrid is nothing more complicated than a transformer. You can think of it as a transformer with a 2-wire primary side and two 2-wire secondary sides which are carefully balanced to appear equal. This device is located at the point where the ordinary 2-wire POTS line is connected to the long distance toll trunks which are 4-wire circuits. The more carefully balanced the Hybrid is, the less reflections from it there will be, and the better it's return loss.

Return Loss is "better" the higher the reading, so numbers in excess of 25-30 dB are good, while numbers below 20 dB may indicate problems on a 4-wire trunk. Generally speaking, 2-wire Return Loss readings on actual trunks are not that good and average around 10 to 15 dB.

The amount of loss across the Hybrid is used as a correction factor to the Return Loss measurement. The loss may be known from previous measurements (in which case it can simply be entered), or it may be measured by the 930A. In either case, the 930A will automatically correct it's Return Loss readings accordingly.

To measure Trans-Hybrid Loss, you must be able to get at the Hybrid because you will need to short out its 2-wire primary while you measure the 4-wire Return Loss at the secondary side. If you cannot do this, then do what everyone else does and ignore **THL**. Leave it at the default of 0 dB.

If you are determined to measure this parameter, then proceed with the following steps.

1. Connect the 930A to the 4-wire side of the Hybrid, as close to it as practical, and set the **TRUNK TYPE** to the correct trunk for testing.

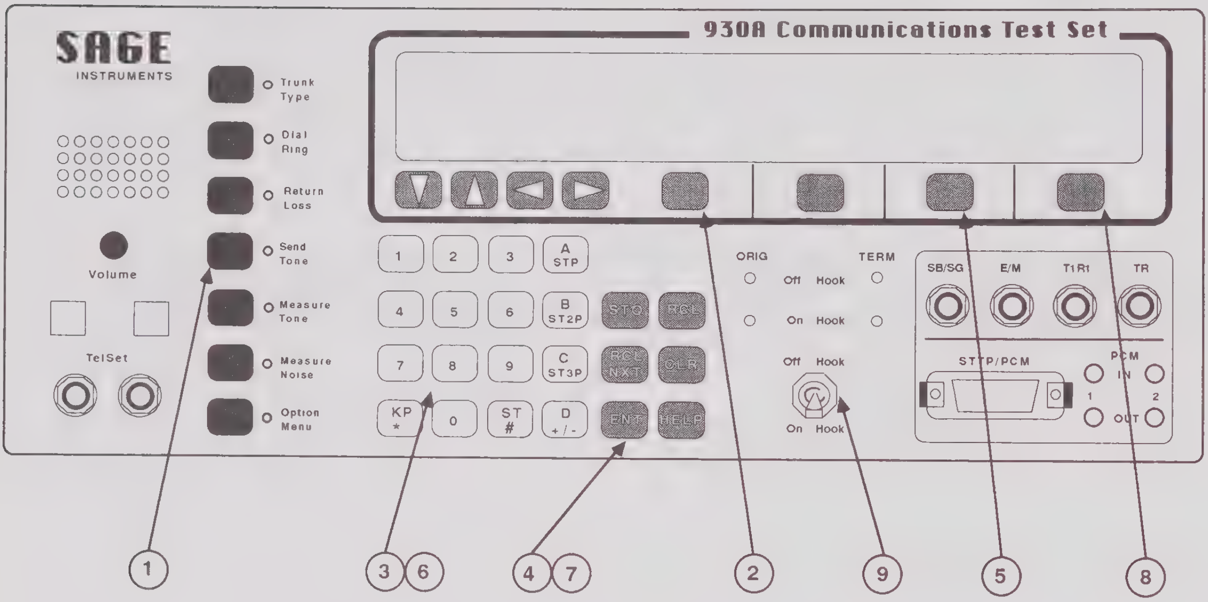
2. Short the 2-wire side of the Hybrid using a jumper cable.

3. Press the **RETURN LOSS** function key on the 930A. It should not matter what pattern you send but you may, for example, use **ERL,** or perhaps **OSC** set to 1004 Hz. This puts you at mid-band for the measurement, which is a good idea.

4. Press Softkey 3 and the 930A will measure the **THL** and the value will appear over Softkey 3.

5. Press Softkey 3 again and the 930A will prepare to set the measured value in as the **THL** correction.

6. Press Softkey 3 again and the measured value will be accepted. If you want to enter something else don't press Softkey 3. Enter the number you want using the numeric keypad when the cursor is flashing over the measured value in Step 5.



To Send a Tone:

1. Press the **SEND TONE** function key.
2. Press Softkey 1 to allow frequency changes.
3. Enter the desired frequency using the numeric keypad.
4. Press the **ENT** (Enter) key to enter the frequency.
5. Press Softkey 3 to allow level changes.
6. Enter desired level using numeric keypad.
7. Press the **ENT** key.
8. Press Softkey 4 to turn on the generator or to turn it off and supply quiet termination.
9. Ensure that Hook Switch is **OFF HOOK** to send tones.

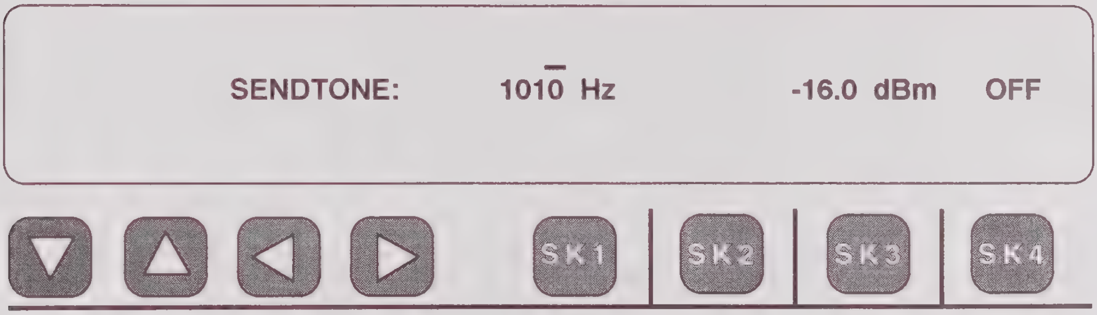
SENDING A TONE
FIGURE 3-11

3-7 HOW TO SEND A TONE FROM THE 930A

This is one of the most used functions in any test set. You can press the **SEND TONE** function key and then the **HELP** key; the 930A will walk you through the procedure, or you can refer to Figure 3-11.

It's a lot faster if you just use the keys under the display and the numeric keypad to send what you want.

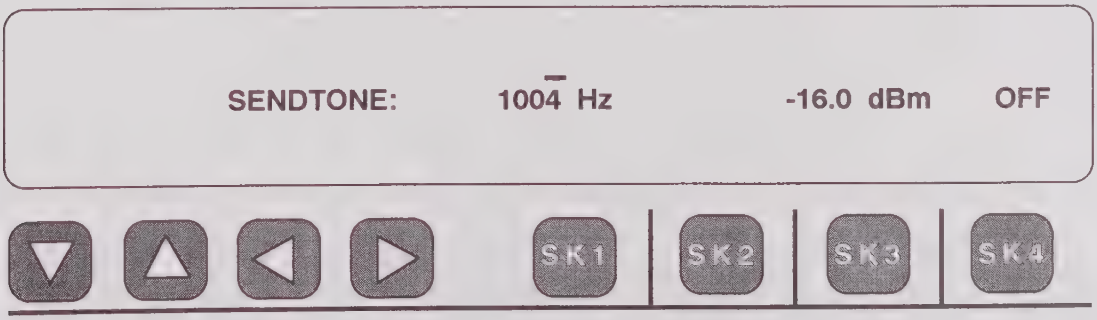
Let's start with the default display to get acquainted with the way things work.



SENDTONE: 1010 Hz -16.0 dBm OFF

Note the cursor over the frequency display. This means you can change the frequency if you want. If the cursor is over the level, press Softkey 1 to move it over the frequency. The sender is turned **OFF** in the above display.

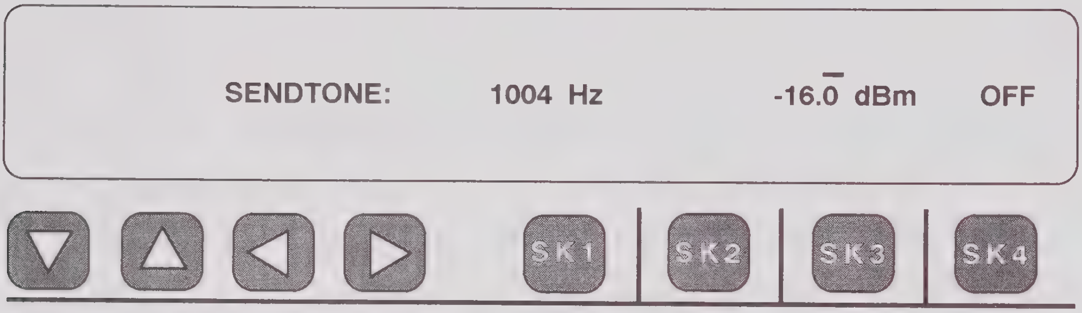
To change the frequency to 1004 Hz, enter the numbers **1, 0, 0,** and **4** from the keypad, press the **ENTER** key, and the display will be:



SENDTONE: 1004 Hz -16.0 dBm OFF

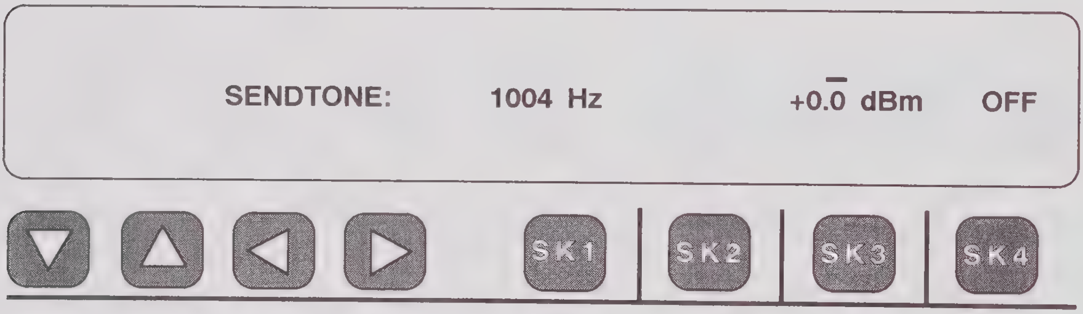
You can also use the **UP/DOWN** and **LEFT/RIGHT** Arrow keys to do the same thing.

To change the level, press Softkey 3 (under the level) and the cursor will move from the frequency to the level as shown below:



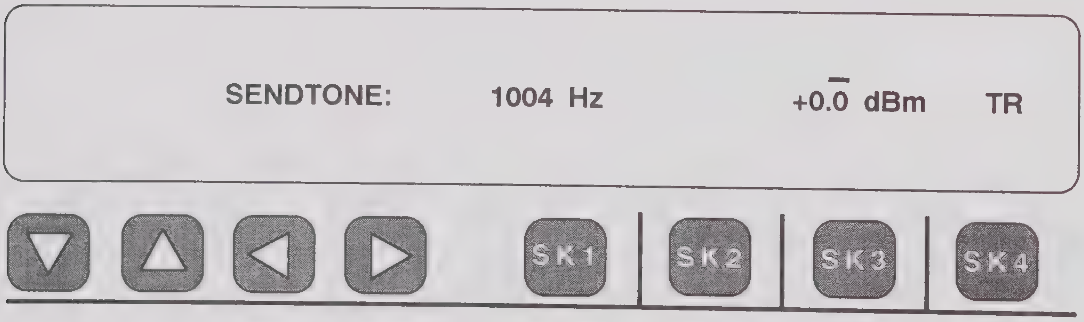
SENDTONE: 1004 Hz -16.0 dBm OFF

To change the level to 0 dBm, press the number **0** on the keypad, press the **ENTER** key, and the display will change to:



SENDTONE: 1004 Hz +0.0 dBm OFF

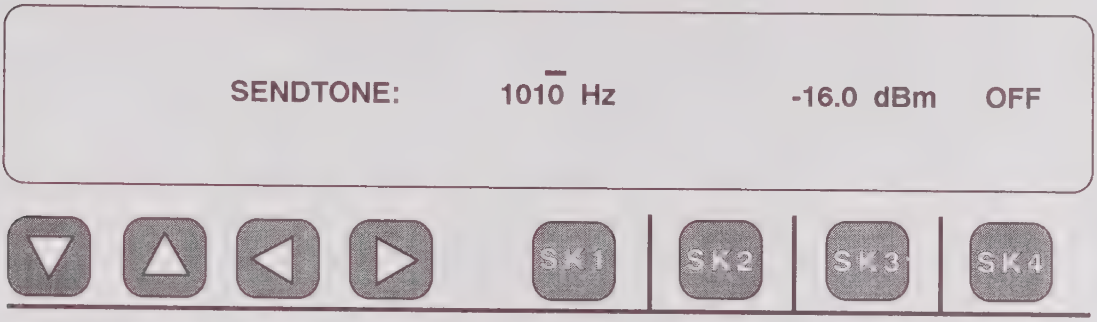
All that remains is to go **OFF HOOK**, press Softkey 4 (under **OFF**), and the display will become:



SENDTONE: 1004 Hz +0.0 dBm TR

In this case, the 1004 Hz tone at 0.0 dBm level is being sent from the Tip-Ring (**T/R**) jack. Depending on the direction you were simulating this could have been **T1R1**, or it could have been **PCM1** or **PCM2** if you have either of the T-1 PCM options.

3-7.1 DETAILS OF THE SEND TONE FUNCTION



The functions of the front panel keys in the **SEND TONE** mode are:

Softkey 1 moves the cursor to the least significant digit of the frequency display. Numeric input will be treated as a frequency selection.

Softkey 2 is inactive.

Softkey 3 moves the cursor to the least significant digit of the level display. Numeric input will be treated as a level selection.

Softkey 4 toggles between Tone **ON** and Tone **OFF**. If the tone is **ON**, **"TR"**, **"T1R1"**, **"PCM1"**, or **"PCM2"** will be displayed depending upon the Trunk Type and direction. If **OFF** is selected, no tone is sent and the 930A supplies quiet termination. Whenever the Model 930A is operating in a mode other than **SEND TONE** and a tone is being sent, the LED beside the **SEND TONE** function key will flash to alert you to the fact that tone is being sent. If no tone is desired, return to the **SEND TONE** function and use Softkey 4 to place the unit in Quiet Termination by selecting "**OFF.**" The tone selected in **SEND TONE** is not sent in the **DIAL/RING** or **RETURN LOSS** functions.

The LEFT/RIGHT Arrow keys position the cursor within a selected field, either frequency or level, from least significant to most significant digit.

The UP/DOWN Arrow keys increment or decrement the frequency or level depending upon the position of the cursor. The step size depends upon the position of the cursor within the field and may be either 1, 10, 100, or 1000 Hz in frequency or 0.1, 1, or 10 dB in level.

Holding down the **UP** or **DOWN** Arrow keys will cause the Model 930A to sweep through the frequency or level steps. By selecting the appropriate frequency step size, you can generate a manual frequency sweep.

The Model 930A is capable of automatically sweeping tones over user-defineable ranges. This standard feature is described in Section 3-10.8 since it is accessed under the **Option Menu** key.

NOTE:

The Model 930A does not go above 3904 Hz in the **PCM** mode.

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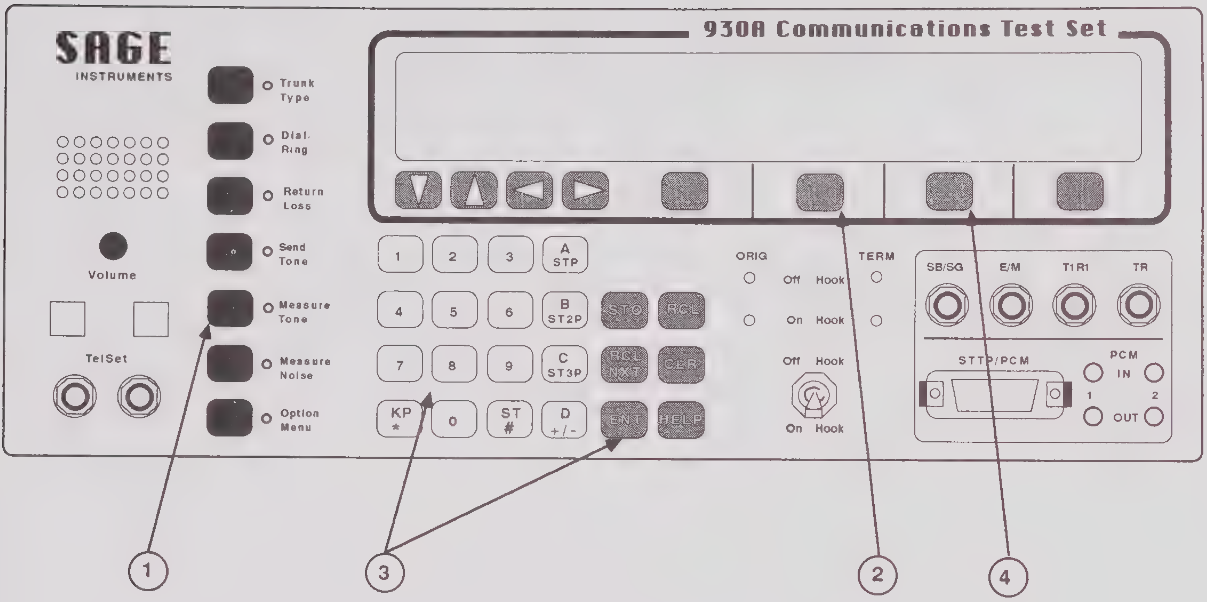


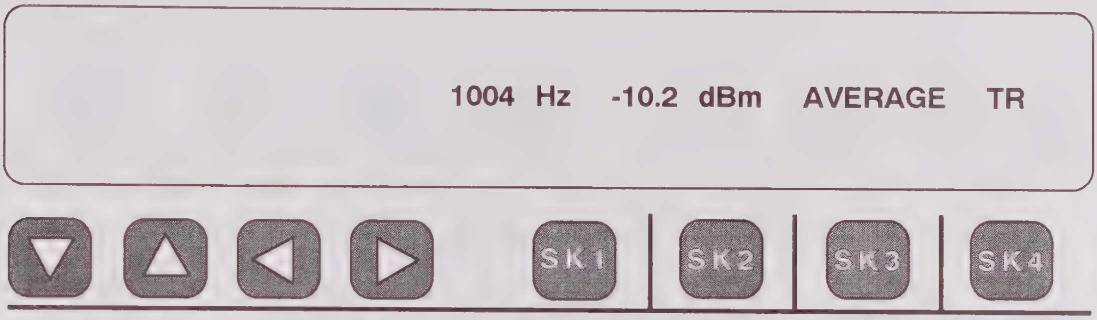
To Measure a Received Tone:

1. Press the **MEASURE TONE** function key.
2. Press Softkey 2 to enter the **TLP** correction factor, measure in dBm, or set a 0 dB reference point for comparisons.
3. Use the numeric keypad to enter the **TLP** correction factor, if required.
4. Press Softkey 3 to change between **Average** and **RMS** detectors.

MEASURING A TONE
FIGURE 3-12

3-8 HOW TO MEASURE THE LEVEL AND FREQUENCY OF TONES

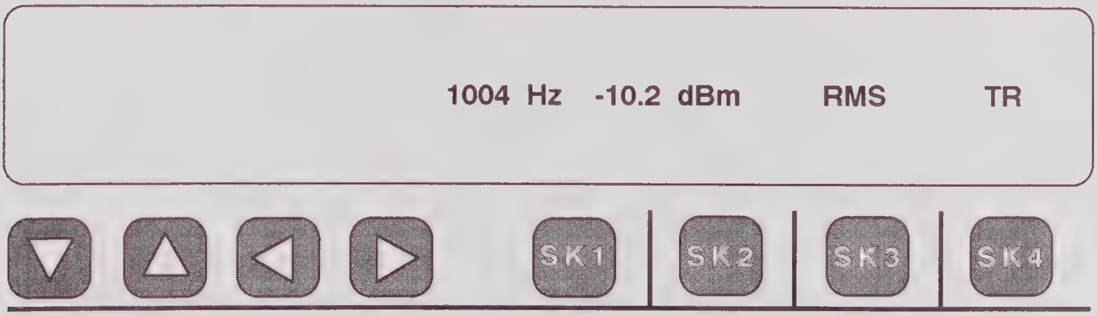
To measure and display the level and frequency of received tones, press the **MEASURE TONE** key. Figure 3-12 shows the locations of the keys and provides step-by-step instructions.



```
1004 Hz   -10.2 dBm   AVERAGE   TR
```

Usually, the absolute level in dBm is measured with an **Average** detector. These are the defaults for the **MEASURE TONE** function.

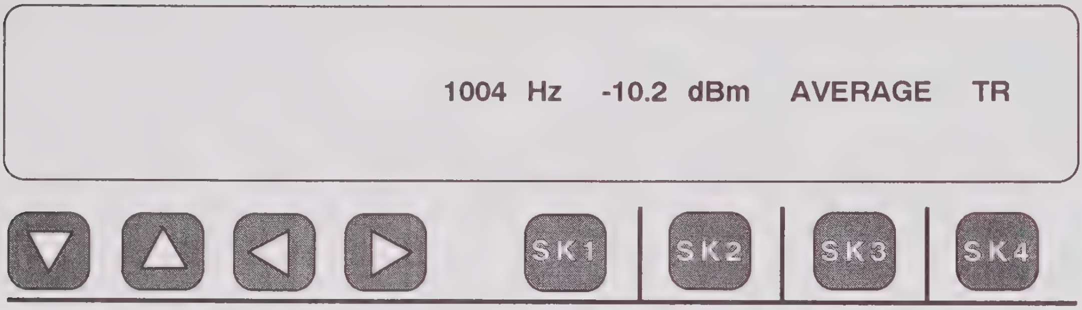
You measure single tones in most cases so the choice of detector will have no impact on your readings. You would only notice a difference if the waveform you were measuring was not a sinusoid. For such waveforms, the **RMS** detector is recommended. Pressing Softkey 3 will toggle between **Average** and **RMS** and the display would be:



```
1004 Hz   -10.2 dBm     RMS     TR
```

You will note that Softkeys 1 and 4 are inactive. Softkey 2 is active and allows you to set a 0 dB reference level for differential measurements or to measure relative to a specific TLP in dBm0. This is explained in the following section.

3-8.1 DETAILS OF KEY OPERATION IN MEASURE TONE



The functions of the front panel keys in the **MEASURE TONE** mode are:

Softkey 1 is inactive.

Softkey 4 is inactive. The display above it shows the input from which the measurements are being taken, i.e., **TR**, **T1R1**, and optionally, **PCM1** or **PCM2**.

Softkey 3 toggles between the **Average** and **RMS** detectors. **Average** is the most commonly used.

Softkey 2 acts like a wheel and enables you to select the zero dB level relative to the current measurement. Initially the 930A displays the measurement in dBm and always returns to dBm when power is cycled. Press Softkey 2 once to lock in the current measured value as the 0 dB reference point. Pressing Softkey 2 again enables you to input a relative zero numerically (Numeric entry from the front panel keypad must be terminated by pressing **ENTER** or any softkey). Another press of Softkey 2 will return the 930A to dBm measurement. For convenience, the 930A displays measurements in dBm (absolute relative to 1 milliwatt), dB (relative to a measured zero), or dBm0 (relative to a specified zero or transmission level point).

Accurate measurements can only be made if the proper impedance has been selected in **TRUNK TYPE** mode.

In Loop and Ground Start modes, the position of the Hook Switch can affect the AC Termination and, therefore, the measured level. Measurements in these trunk types should always be made with the 930A **OFF HOOK**.

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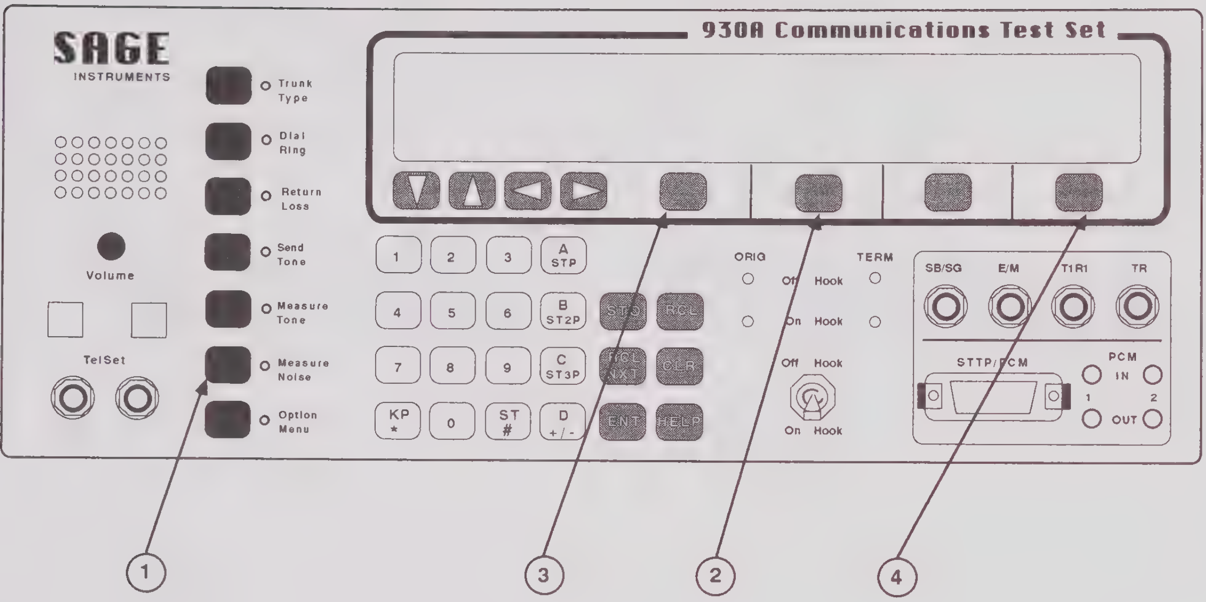


To Measure Noise or Signal-to-Noise:

1. Press the **MEASURE NOISE** function key.
2. Press Softkey 2 to select weighting filter (**3 KHz FLAT, C-MESSAGE, or C-NOTCH**), or Signal-to-Noise (**S/N**).
3. Press Softkey 1 to select relative dB (dBrn or dBrnC), 0 dB reference point, or to enter TLP correction factor.
4. Press Softkey 4 to select Balanced or Noise-to-Ground measurements.

NOISE MEASUREMENT
FIGURE 3-13

3-9 HOW TO MEASURE NOISE AND SIGNAL-TO-NOISE

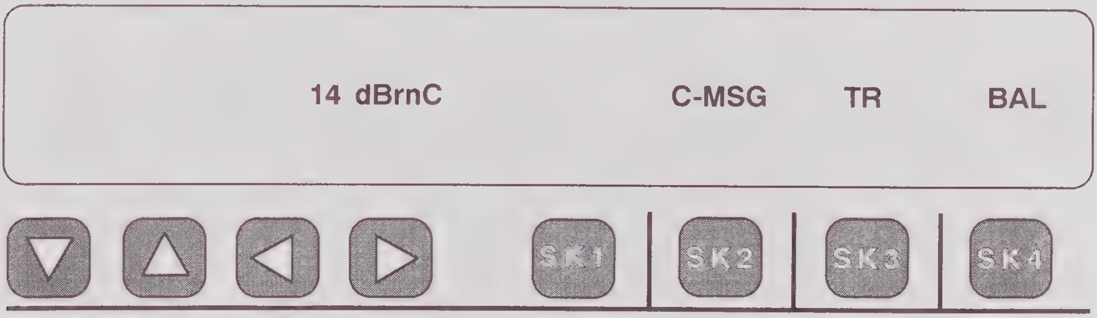
Noise measurements are made with the far end of the circuit terminated in what is called a "**Quiet Termination.**" This is either a 600 or a 900 ohm resistor in series with a 2.16 microfarad capacitor. The operating telephone companies have, for a long time, used test lines which can be dialed up at the far end of the circuit to provide the quiet termination. These are known as Type 100 test lines or responders using the terminology of AT&T.

Once you have set the correct Trunk Type in the 930A, you can use the **DIAL/RING** mode to call the far end Type 100 test line. This will place a quiet termination on the line.

To measure Noise using the 930A, press the **MEASURE NOISE** function key. This causes the 930A to display the current measurements, filter weighting types, source, and balance. Figure 3-13 shows the location of the keys and provides step-by-step instructions for noise measurements.

The Model 930A measures **C-Message, C-Notched, and 3 KHz Flat** weighted noise, as well as **Signal-to-Noise Ratio**, on 2- and 4-wire metallic circuits, or 64 Kbps DS-0 channels (optional).

A typical display might appear as:



This is a measurement of C-Message weighted noise in dBrnC made at the Tip/Ring input in the balanced mode.

Pressing Softkey 2 will page you through the other filter types. Softkey 4 toggles you between balanced and noise-to-ground measurements.

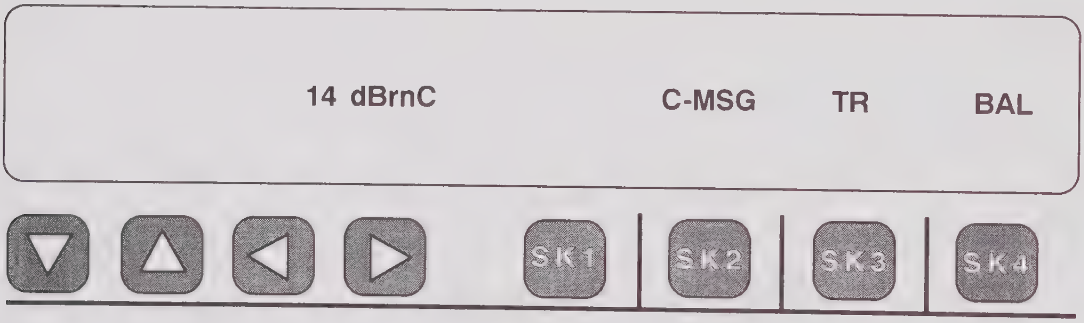
3-9.1 EXAMPLE OF MEASURING SIGNAL-TO-NOISE

Suppose you need to check the **S/N** ratio on a 2-wire 900 ohm circuit to see if the circuit can meet the requirements of a 9600 baud, half duplex Modem which needs a minimum **S/N** ratio of 28 dB according to its specifications. **REMEMBER:** The 930A must be receiving a 1010 Hz +/-15 Hz tone (or milliwatt) from the far-end on 2-wire trunks, or it must be sending 1010 Hz in a loopback mode on 4-wire trunks, to measure **S/N** ratio.

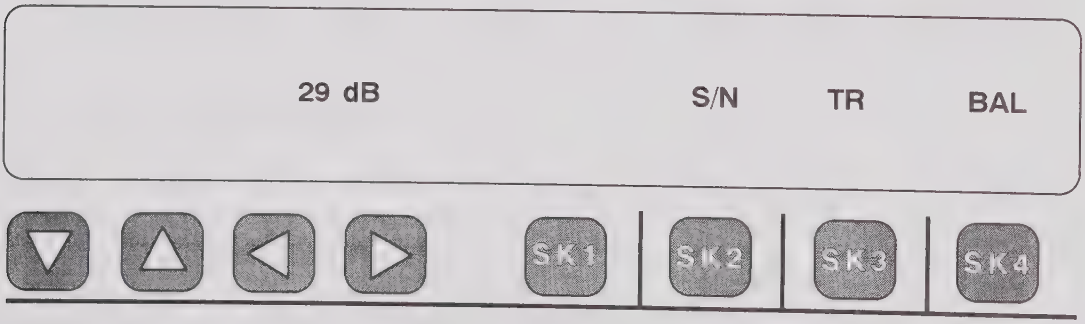
After setting up the 930A to the correct **TRUNK TYPE**, call the local milliwatt number to get a 1004 Hz tone sent back. Alternately, contact someone at the other end of the circuit and have them send 1004 Hz back. **Next**, select the **MEASURE NOISE** function.

Press the Measure Noise key.

Assume that the 930A display is similar to the one shown below after the **Measure Noise** key is pressed.



To select the **S/N** ratio display, press Softkey 2 until the display is:



REMINDER: The **S/N** ratio measurement requires that a holding tone be present at the measuring end of the circuit. On 2-wire trunks this usually means making an end-to-end measurement with one test set supplying 1004 Hz from one end and the other test set measuring the **S/N** at the other end. On a 4-wire trunk, the far end can be looped back. In this case the 930A can generate a 1004 Hz tone at the appropriate level and then measure the **S/N** ratio coming back.

3-9.2 DETAILS OF KEY OPERATION IN MEASURE NOISE

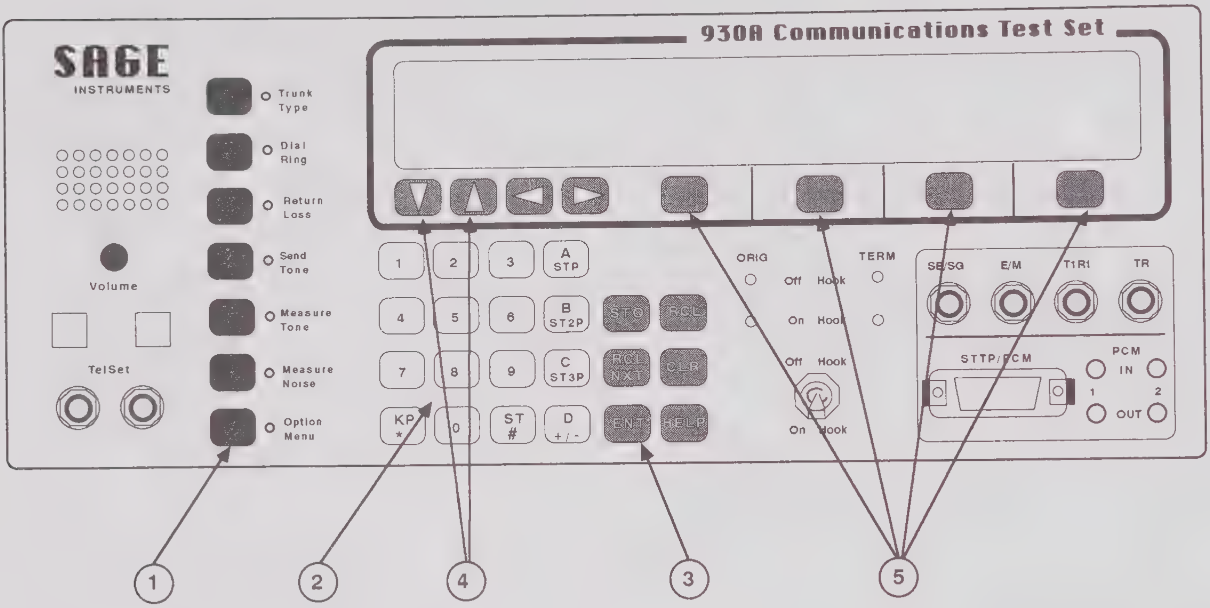
Softkey 1 acts as a wheel and enables you to select the measurement units. That is, dBrn (Absolute), dB (relative to the level being measured when dB was selected), or dBrn0 (relative to a level which is input numerically).

Softkey 2 acts as a wheel and allows you to select the type of weighting filter for a particular measurement. The choices are: **C-MESSAGE, C-NOTCH, 3 KHz FLAT, and S/N**.

Softkey 3 is inactive. The input signal source (**TR, T1R1, PCM1,** or **PCM2**) is displayed above it.

Softkey 4 acts as a wheel and enables you to select balanced or Noise-to-Ground measurements on analog trunks. Optionally, on **PCM** trunks this window is labeled **"CHANNEL"** to indicate that the noise being measured is the noise on one channel and not the entire 24 channels. Softkey 4 is inactive on **PCM** trunks and also during **S/N** measurements which are only done as balanced measurements.

It is possible to set the relative zero, for measurements in dB, using one weighting filter and then change to another filter. The display will then show the measurement in one filter relative to the other. This feature is particularly useful for measuring the notch depth of **C-NOTCH** filters.



To Select Menu Options:

1. Press the **OPTION MENU** key.
2. Enter the number of the Menu Option desired (1 to 98).
3. Press the **ENT** (Enter) key to initiate the Menu Option choice.
4. Alternatively, after Step 1, you may use the **UP/DOWN** Arrow keys to scroll through the Menu Option choices.
5. In this case, press any softkey to enter inside the desired Menu Option once it has been selected.

MENU OPTION SELECTION
FIGURE 3-14

3-10 FINDING WHAT YOU WANT UNDER THE OPTION MENU KEY

The good part about the **OPTION MENU** key is, it permits the capabilities of the 930A to be expanded without replacing the front panel. The bad news is, multiple functions are located under a single key. Figure 3-14 explains how to select a function under the **OPTION MENU** key. The following is a list of the Menu Options which come standard with all 930A's. A complete listing of all Menu Options (standard plus optional) is listed in Table 4-1 on pages 4-3 and 4-4.

TABLE 3-1
STANDARD MENU OPTION LOCATIONS

MENU OPTION NUMBER		DESCRIPTION	SECTION
OPTION NUMBER:	1	MODIFY DIAL/RING	3-10.2
OPTION NUMBER:	2	SEND DIGIT SEQUENCES	3-10.3
OPTION NUMBER:	6	DC VOLT/AMP METER	3-10.4
OPTION NUMBER:	7	SUPERVISION THRESHOLDS	3-10.5
OPTION NUMBER:	8	SUPERVISION MONITOR	3-10.6
OPTION NUMBER:	9	WINK TIMING	3-10.7
OPTION NUMBER:	10	FREQUENCY SWEEP	3-10.8
OPTION NUMBER:	15	BEEP ON ERROR	3-10.9
OPTION NUMBER:	30	ADJUST TLP	3-10.10
OPTION NUMBER:	31	SEND HOOK FLASH	3-10.11
OPTION NUMBER:	32	DIAL-UP TESTLINE	3-10.12
OPTION NUMBER:	33	DIAL-UP SWEEP	3-10.13
OPTION NUMBER:	35	DUAL-TONE SENDER	3-10.20
OPTION NUMBER:	65	GND-ST COIN PHONE	3-10.21
OPTION NUMBER:	90	DSP MEMORY TEST	3-10.14
OPTION NUMBER:	91	SOFTWARE VERSION	3-10.15
OPTION NUMBER:	92	SOFTWARE COLD-BOOT	3-10.16
OPTION NUMBER:	93	TEST DISPLAY	3-10.17
OPTION NUMBER:	94	LIST OPTIONS	3-10.18
OPTION NUMBER:	95	DRY CIRCUIT	3-10.19

Menu Option 94 is useful if you want to find out what **purchased** options are installed in your 930A.

All other menu numbers up to 98 are either used by purchased options or are reserved for future expansion. They may be labeled if you have purchased the corresponding option or they may say "Not Installed."

3-10.1 HOW TO GET INTO THE MENU ONCE YOU FIND IT

There are two ways you can get into the Menu Option of your choice. After pressing the **OPTION MENU** key you will see the last selected menu. It could be, for example, **OPTION NUMBER: 6 DC VOLT/AMP METER**. Suppose you want to adjust the Transmission Level Point (**TLP**) of the receiver. You will need to get to Menu Option 30. **One method** is to enter the number 30 using the keypad and press **ENTER**. This gets you right inside Menu 30 and you can start adjusting. **The other way** to do this is to page upward through the menus using the **UP** Arrow key (or **DOWN** Arrow key as appropriate). When you get to Option Number 30 this way, you will still be on the outside. In order to get inside the menu, you simply press any softkey (**SK1, SK2, SK3, or SK4**) under the display and this will get you inside the menu. This procedure is true for all Menu Options, whether they are standard or optional.

You can get out of any of the Menu Options by pressing the **OPTION MENU** key, or any of the other 6 function keys, as many times as necessary. In many cases, one of the softkeys inside the Menu Option will be labeled **EXIT**, and pressing this softkey will have the same effect. **Remember** that you enter a Menu Option from the outside by pressing any softkey and you can back out of any menu by pressing the **OPTION MENU** key.

NOTE:

The option numbers for the **OPTION MENU** functions should not be confused with the order numbers of purchased options.

NOTE: To store the parameters which have been set up in a Menu Option, it is necessary to exit from that option. To do this, press the **OPTION MENU** key as many times as necessary to get outside, then press the **STORE** key and enter the desired storage location number (01 to 39). The only exception to this is **Option Number 1: MODIFY DIAL/RING**. This is explained in greater detail in Section 3-10.2.

The functions of these Menu Options and their operation is described in Sections 3-10.2 to 3-10.21. This manual covers the function and operation of the purchased options, as they relate to the **OPTION MENU**, in Sections IV, V and VI.

3-10.2 CHANGING THE DIAL/RING DEFAULTS (MENU OPTION 1)

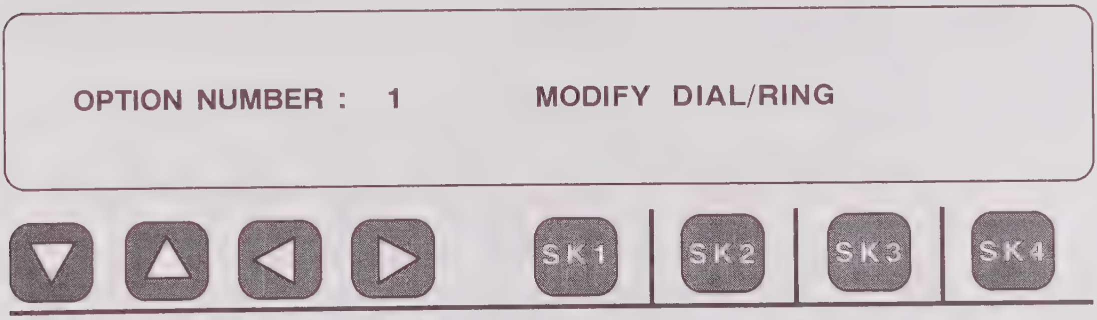
You must first select the type of digits you want to modify under the DIAL/RING function before going to the OPTION MENU function and selecting Option Number 1.

After you have selected the type (**MF, DTMF or DP**) of digits you are going to modify, you can perform the following steps.

Press the OPTION MENU ○ **Option Menu** function key.

Use the UP/DOWN ▽ △ arrow keys to select Menu Option 1: MODIFY DIAL/RING.

The Model 930A display will appear as follows:



OPTION NUMBER : 1 MODIFY DIAL/RING

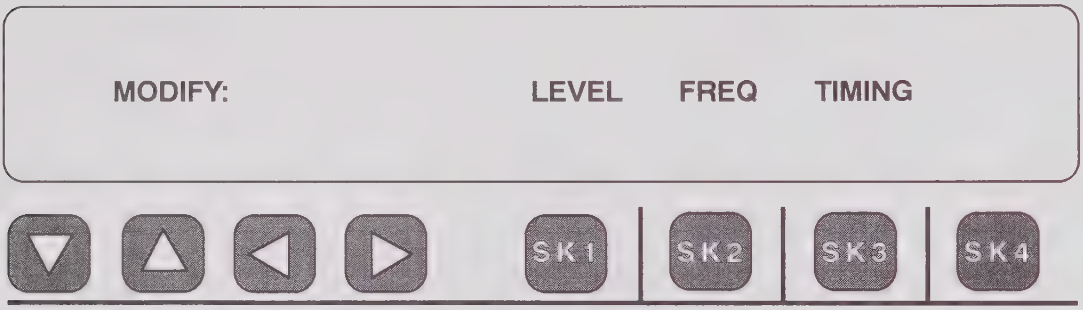
Press any softkey to enter the function.

> **NOTE:** Entering a **1** and pressing the **ENTER** key will cause the 930A to go directly to Menu Option 1 and enter it.

Once you have entered the function, there will be one of two possible displays shown. For **MF** or **DTMF** the display is the same. Only the display for **DP** is different. The following sections will describe how to modify the different types. This section will consider only the modification of outpulsed digits which is a standard feature. The modification of the Ring Generator parameters is covered in Section 4-7. The Ring Generator is purchased Option 930A-13.

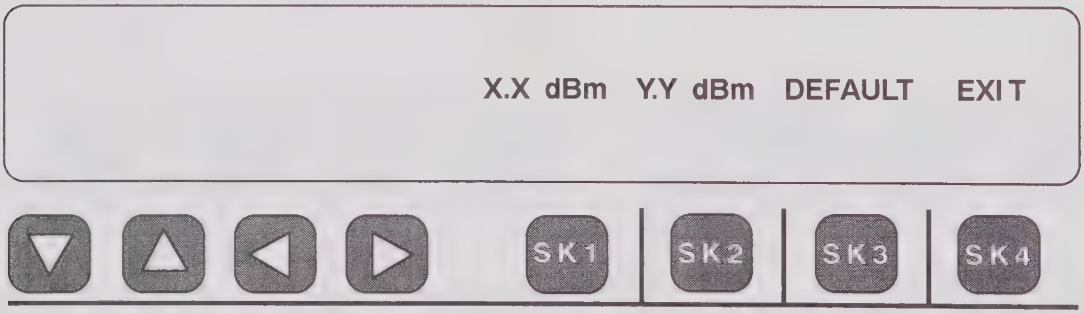
3-10.2.1 CHANGING THE LEVEL, FREQUENCY AND TIMING OF MF OR DTMF DIGITS

After selecting the **MF** or **DTMF** mode under **DIAL/RING**, the **MODIFY SEND DIGITS** display would be:



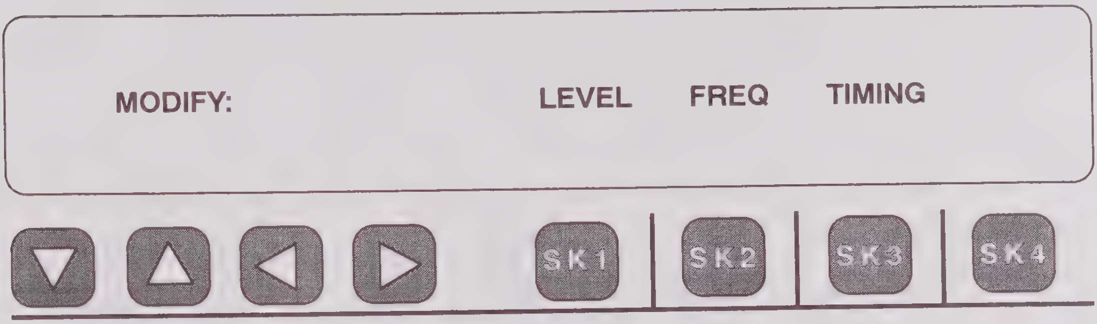
Use Softkey 1 to inspect or modify the tone levels.
Use Softkey 2 to inspect or modify the tone frequencies.
Use Softkey 3 to inspect or modify the timing.

To change the output level of the digits, press Softkey 1 (under **LEVEL**) to bring up the following display:

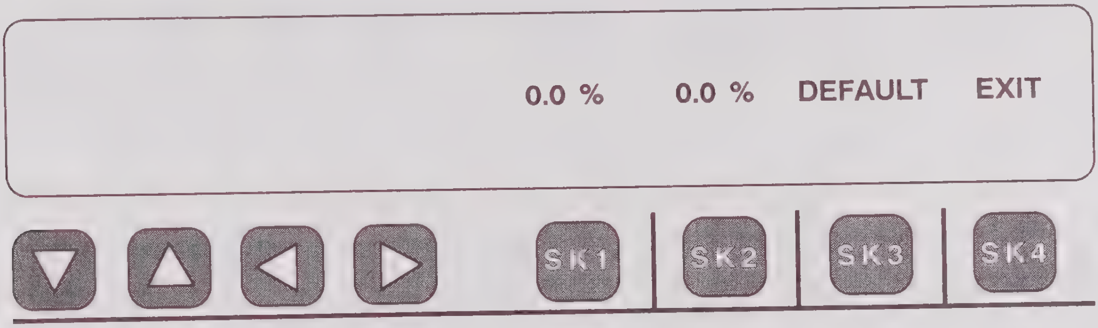


where X.X and Y.Y are the levels at which the low tone and high tone, respectively, are being sent. Typically these are 0.0, -7.0 or -23.0 dBm (7 dB below the **TLP** as a default) depending upon Trunk Type selected.

Softkey 1 selects the **LOW** tone level to be modified.
Softkey 2 selects the **HIGH** tone level to be modified.
Enter another level using the Numeric Keypad.
Softkey 3 selects the **DEFAULT** levels.
Softkey 4 will return you to the main selection display.



To change the frequencies of the digits being sent, press Softkey 2 (under **FREQ**):

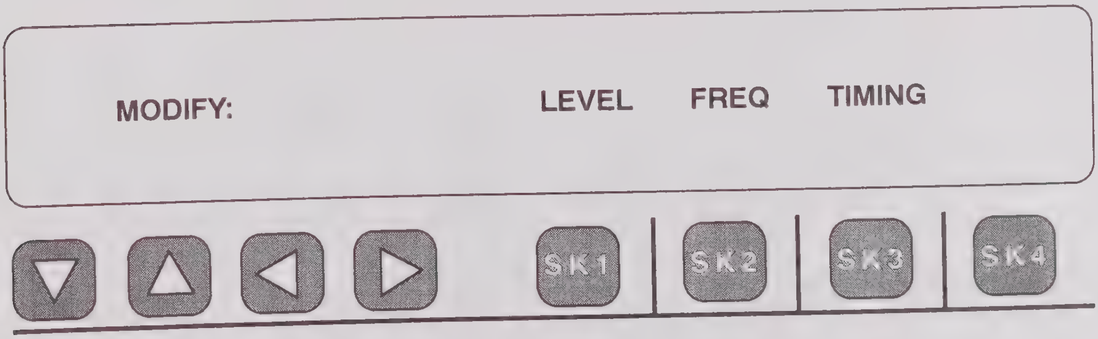


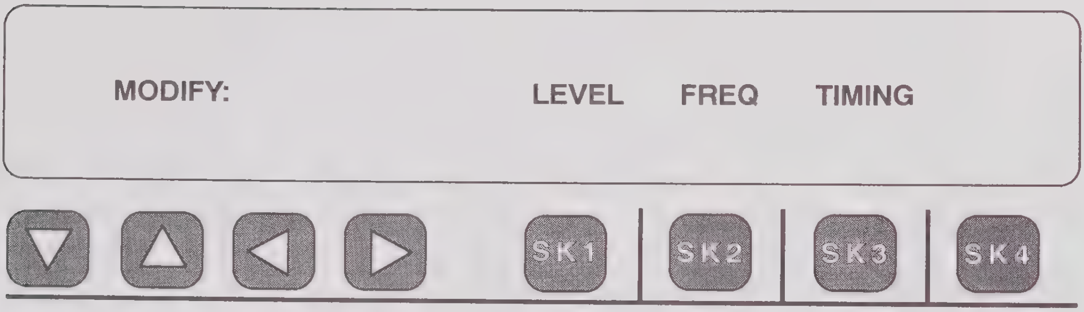
0.0% is the default, indicating no change in tone frequencies.

Softkey 1 (**LOW** Tone) and **2** (**HIGH** Tone) select which tone frequency is to be modified. Press one or the other, enter the percentage (either + or -) from the keypad, and press **ENTER**. Typical values might be +/- 2%.

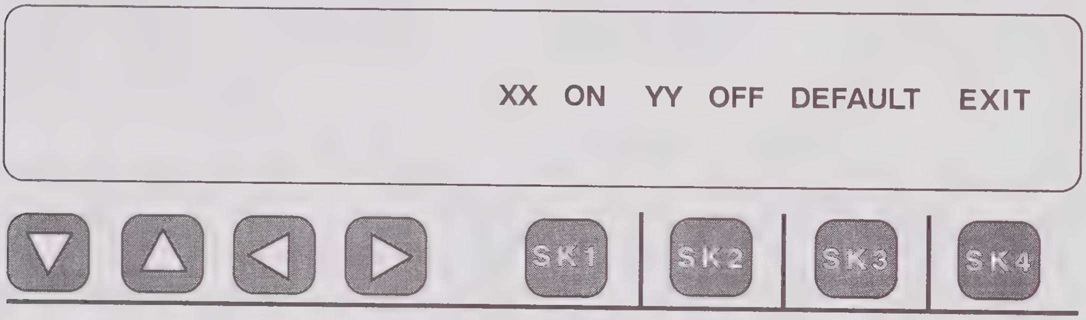
Softkey 3 selects the **DEFAULT** or unmodified values.

Softkey 4 returns you to the **"MODIFY"** display.





To change the timing of the digits you are outpulsing, press Softkey 3 (under **TIMING**):



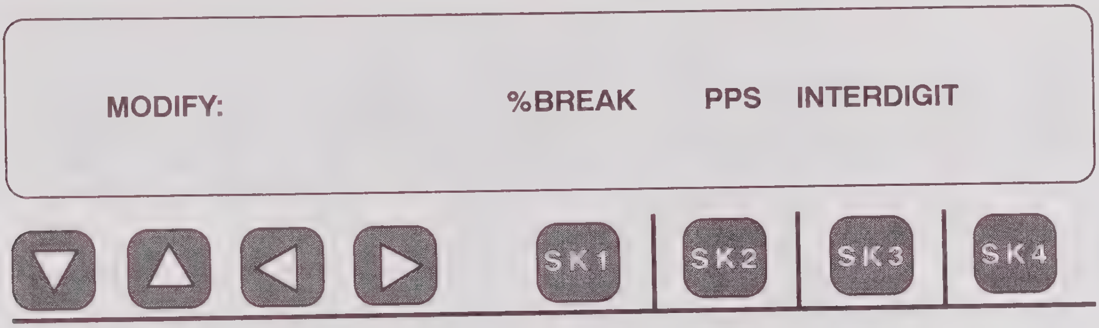
XX is the number of milliseconds the tones are **ON** and **YY** is the Interdigit time (time between tones) in milliseconds. These are typically 50 milliseconds **ON** and **OFF** for **DTMF** and **70** milliseconds for **MF**.

> **Softkeys 1 and 2** select whether On or Off time is to be modified. Then you enter the desired time from the keypad.
>
> **Softkey 3** enters the **DEFAULT** values. These will vary depending upon whether **MF** or **DTMF** has been selected.
>
> **Softkey 4** will return you to the **MODIFY** display.

Pressing any function key will exit to that function, causing the modifications to be retained in non-volatile memory. **In the DIAL/RING function, any sequence of digits which is outpulsed will be sent with the modifications you set in the MODIFY DIAL/RING menu.**

3-10.2.2 HOW TO CHANGE % BREAK, RATE AND INTERDIGIT TIME OF DIAL PULSE (DP) DIGITS

After selecting **DP** digits under the **DIAL/RING** function, a different **MODIFY SEND DIGITS** display will be presented when you enter Option Number 1.



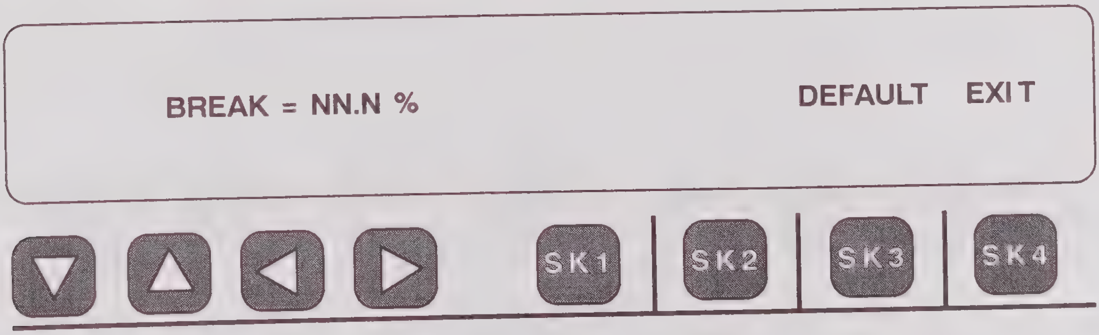
Softkey 1 lets you change the On Hook percentage of the pulse.

Softkey 2 lets you change the number of pulses per second.

Softkey 3 lets you change the Interdigit timing.

You can press any function key to exit.

To change the % BREAK, press Softkey 1 (under **%BREAK**):



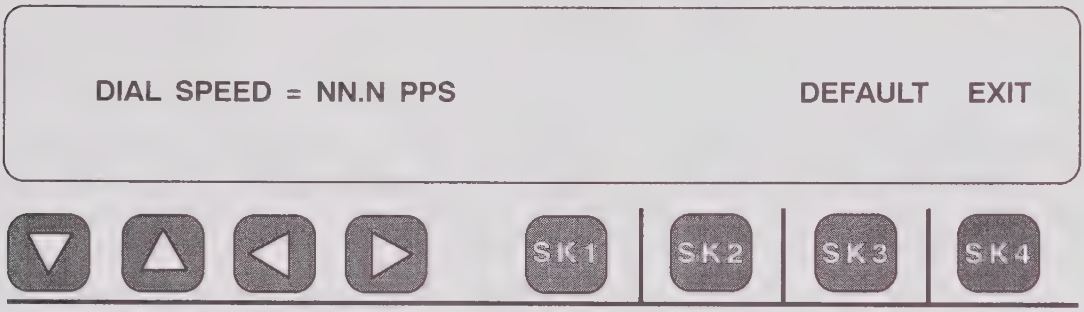
NN.N is the **ON HOOK** percentage of each pulse (default is 60.0%).

Enter the percentage you want from the keypad.

Press **Softkey 3** to reset the % to the 60.0% **DEFAULT** when you are finished testing.

Press **Softkey 4** to **exit** back to the main menu display.

To change the Dialing Speed, press Softkey 2 (under **PPS**):



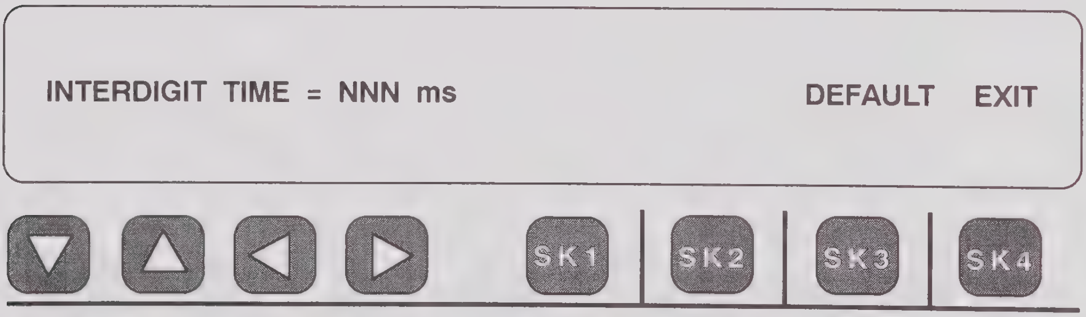
NN.N is the number of pulses per second.

Change the dial speed using the keypad to enter a new value.

Press **Softkey 3** to change back to the 10 PPS default after you are finished with the test.

Press **Softkey 4** to **exit** back to the main menu.

To change the INTERDIGIT TIME, press Softkey 3 (under **INTERDIGIT**):



NNN is the number of milliseconds between digits.

Change the Interdigit Time using the keypad to enter a new value.

Press **Softkey 3** to change back to the 700 msec. **DEFAULT**.

Press **Softkey 4** to **exit** back to the main menu.

3-10.3 HOW TO BUILD A CALL SEQUENCE (MENU OPTION 2)

There will be times when you will want to send more than one phone number in sequence (Feature Group D, TSPS, etc.), or send a very long string of digits (up to 72 digits long), or continuously send a sequence of digits over and over.

Menu Option Number 2: **SEND DIGIT SEQUENCES** is the function which allows you to do these things. It operates in conjunction with the **DIAL/RING** function and the **STORE** function. Sections 3-3.2.1, 3-5, and 3-5.2 describe the details.

The procedure starts with entering the telephone numbers you want to send one at a time in the **DIAL/RING** function. You store each of these strings (for example 4087611000, 5551212, etc.) one at a time in any of the 39 registers (01 to 39). You then select Option Number 2, enter the menu, and input the storage location numbers instead of the phone numbers. This sounds a bit complicated but it is really easy once you have gone through the steps, or have seen it done.

Rather than go through details it is better to look at some examples. The following examples will show you how to send a multi-wink sequence such as a Feature Group D, how to send a simple wink start sequence, and how to send up to a 72 digit long string.

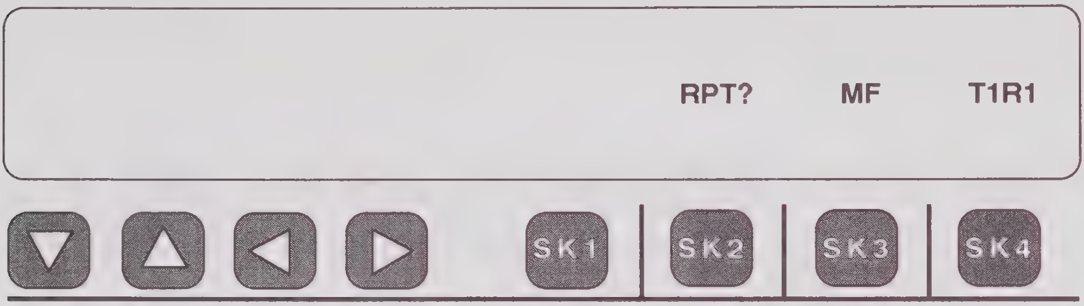
3-10.3.1 HOW TO BUILD A FEATURE GROUP D SEQUENCE IN THE 930A

To build a Feature Group D (Equal Access) call from a Bell Operating Company (BOC) switch to an Interconnect Carrier (IC) through an Access Tandem switch, do the following:

Press the DIAL/RING function key.

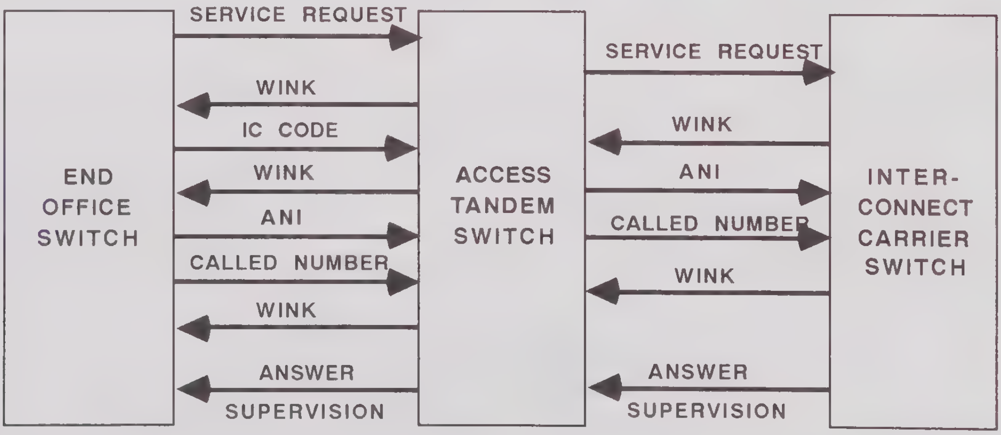
If no sequence has previously been entered, the display will come up blank. Normally, the last number dialed will be showing. Before beginning any data entry you should press the **CLEAR** key to remove any existing sequence from the display.

If there is no other sequence displayed, or after you have pressed the **CLEAR** key, you will see the display below.



If you do not come up into **MF** digits when you enter **DIAL/RING**, press Softkey 3 until **MF** is displayed.

Basically, there are two types of equal access sequences. The 3-stage sequence is found on the input side to the Access Tandem. The 2-stage is found on the output from the Access Tandem toward the Interconnect Carrier. Both are Wink Start trunk calls and the only difference is that the 3-stage includes the Interconnect Carrier's identity code in addition to the calling number (**ANI**) and the called number.



EQUAL ACCESS CALL PROGRESSION DIAGRAM
FIGURE 3-15

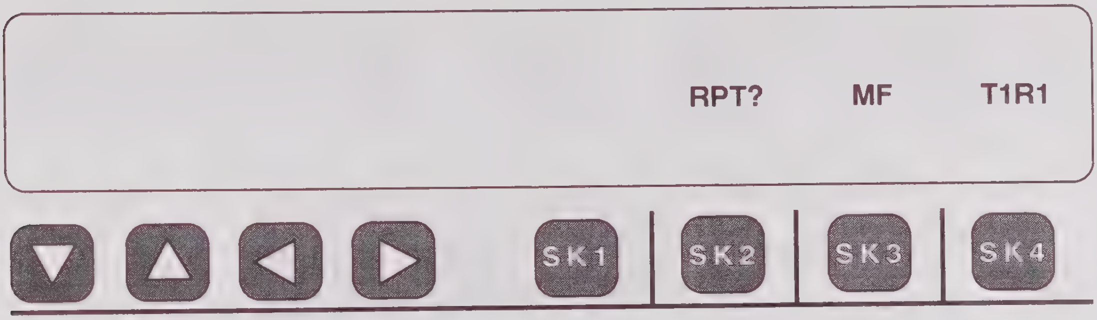
The 3-stage call has the form:

WINK IC CODE WINK CALLING # CALLED # WINK

The 2-stage call has the form:

WINK **CALLING #** **CALLED #** **WINK**

To simulate these calls, enter the numbers to be dialed and store them sequentially into memory. Starting from a blank display, the process is:

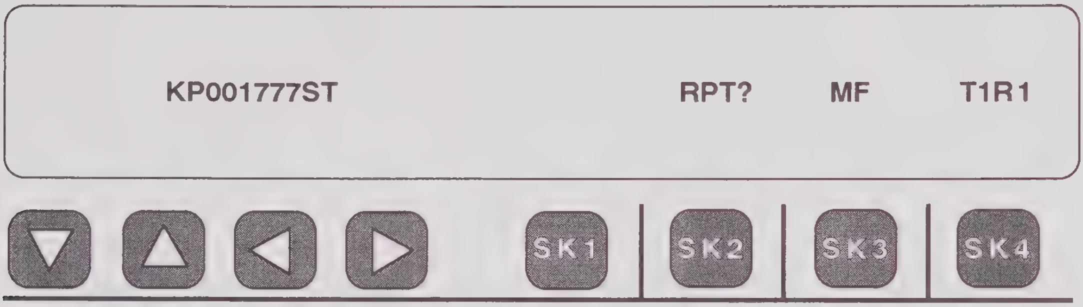


For this example, we will simulate a full Feature Group D call sequence using the number "**KP001777ST**" for the **IC** code, "**KP004087611000ST**" for the calling number (**ANI**), and "**KP4155551212ST**" for the **called number**. Each must be entered and stored separately. The procedure is outlined on the following pages.

Use the Numeric Keypad to enter the IC code, which, for example purposes, is assumed to be "KP001777ST", in MF. That is, press KP * , then press 0 twice, then press 1 , then 7 three times, and finally press ST # .

This is only an example of an IC code. You must check the local codes in effect for your area when doing this for real.

The IC code example display is:



Store this sequence in location 10, for example by pressing the STO 1 0 and ENT keys.

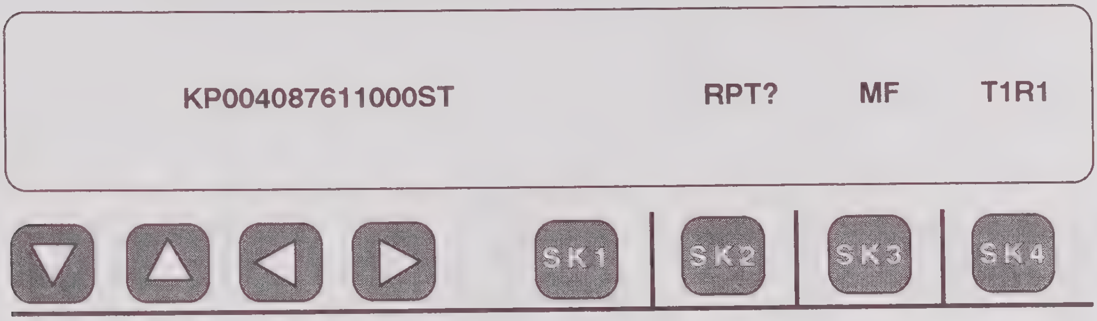
Press the CLEAR CLR key to clear the display and allow entry of the next sequence.

The next step in creating the Equal Access call is to enter the calling number. The **MF** string for the **ANI** is **"KP004087611000ST"** in this example. The first two digits are the information digit pair (for inter-LATA restricted lines), and then the 10 digit **ANI** number (calling number plus area code). The **MF** delimiters **"KP"** and **"ST"** surround the number.

Use the keypad to enter the number as follows:

Press KP *, then press 0 twice, then press 4 0 8 7 6 1 1 0 0 0 and finally, press ST #.

When you have correctly entered the **ANI**, the display will look like:



Store this sequence in location 11 by pressing the STO and ENT keys. Notice that the 930A automatically incremented the register location so that it was not necessary to enter the number 11.

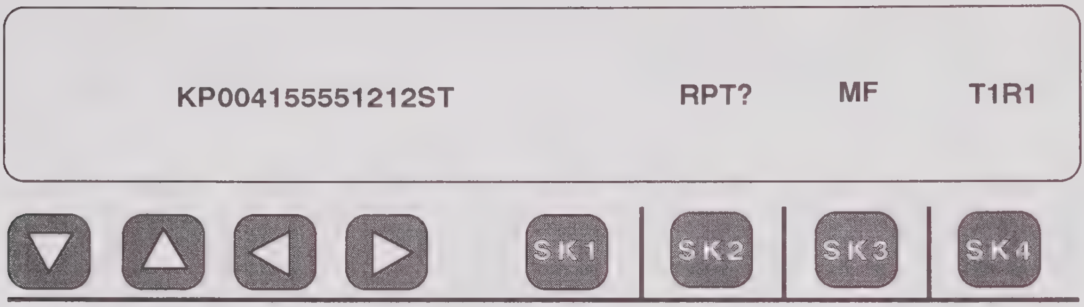
Press the CLEAR CLR key to clear the display and allow entry of the next sequence.

After you have entered the **IC code** and the **ANI** into memory locations 10 and 11 respectively, all you have left is the **called number**.

The final string is the called number (with Area Code). For this example, we used the number "**4155551212.**" In **MF**, this number is surrounded by the **KP** and **ST** delimiters, so we enter it as follows:

Press KP * , then press 4 1 then press 5 four times, then 1 2 1 2 and finally, press ST #.

When you have correctly entered the called number, the display will look like:



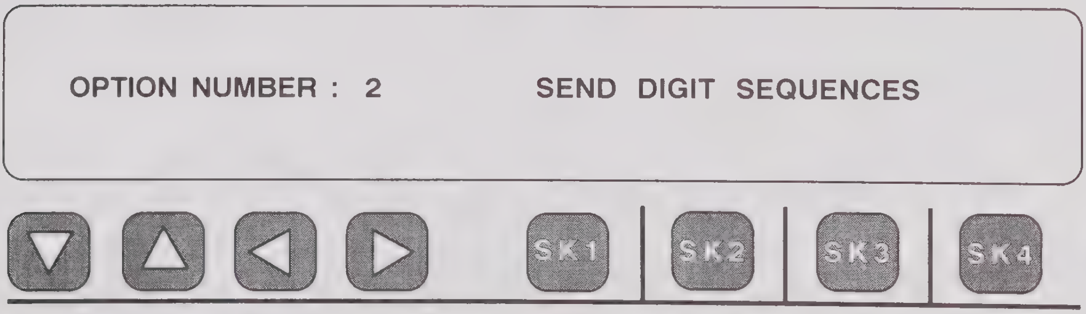
```
KP004155551212ST          RPT?     MF      T1R1
```

Store this sequence in location 12 by pressing the STO and ENT keys.

When you have entered and stored all the numbers, press the **OPTION MENU** key and go to Menu Option 2: **SEND DIGIT SEQUENCES**. To set this menu to send the Equal Access call, do the following:

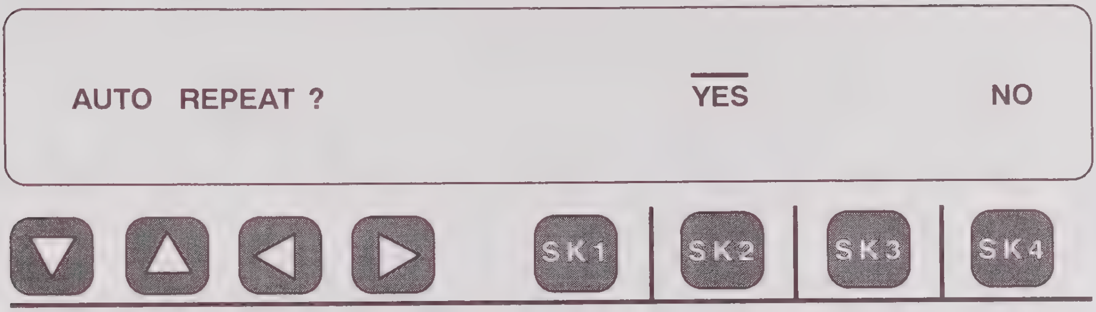
Press the OPTION MENU ○ Option Menu function key.

Use the UP/DOWN ▽ △ arrow keys to select Menu Option 2: SEND DIGIT SEQUENCES.



```
OPTION NUMBER :  2        SEND  DIGIT  SEQUENCES
```

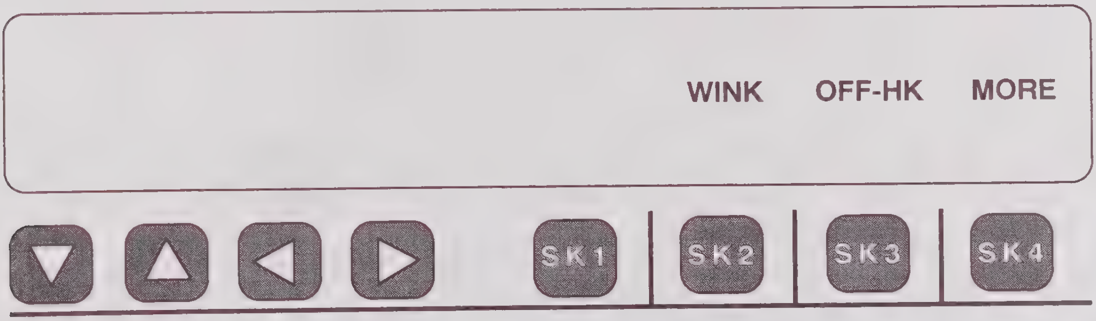
Press any softkey under the display to enter the menu:



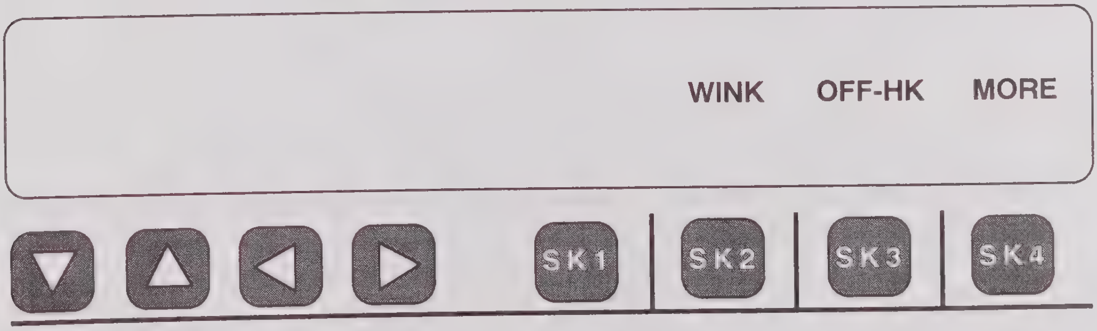
If you press Softkey 2 (under **YES**), the 930A will continuously repeat sending the sequence entered.

If you press Softkey 4 (under **NO**), the 930A will only send the sequence once. This is normally what most people want.

Whichever key you press, the 930A screen will become:



If a previous test sequence is present, press the CLEAR CLR key and the display will show:



Remember, a Feature Group D input to an Access Tandem consists of the **IC Code** number, the **ANI** or calling number, and the **called number**, separated by Wink supervision at the appropriate points. To input the sequence into the above display, do the following:

Press Softkey 2 (under **WINK**) to instruct the 930A to wait for a Wink before outpulsing.

Press 1 and 0 and then ENT

This tells the 930A to send the IC code digits stored in register 10 after it sees the wink.

Press Softkey 2 again to tell the 930A to wait for another Wink between the IC Code number and the rest of the numbers. The 930A will then wait for the second Wink.

Press 1 twice and then ENT

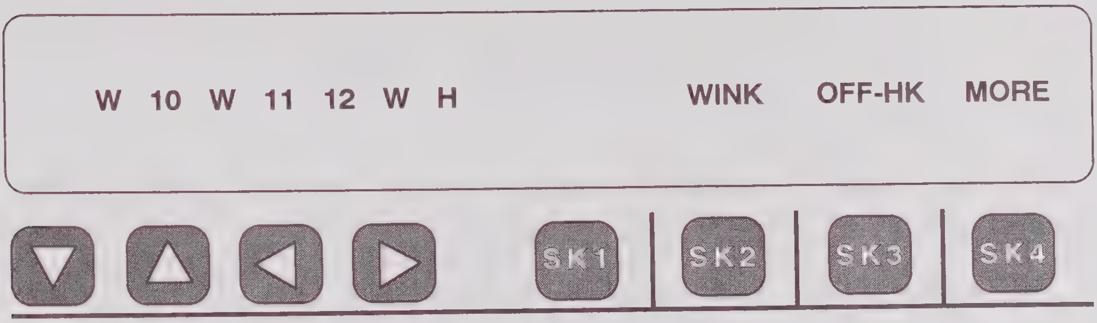
Press 1 and 2 and then ENT .

This instructs the 930A to outpulse the **ANI** and **called number** stored in registers 11 and 12 respectively.

Press Softkey 2 to tell the 930A to look for the final Wink which completes the sequence.

Press Softkey 3 to tell the 930A to expect the far end to go **"Off Hook"** when the call completes.

When you have correctly built the call sequence into the 930A, the display will look like:



where **10** = KP001777ST, **11** = KP00408761000ST, and **12** = KP4155551212ST, in this example.

Look at the example display above and compare it to the form of the 3-stage call repeated below:

WINK	IC CODE	WINK	CALLING #	CALLED #	WINK
W	**10**	**W**	**11**	**12**	**W**

To send the call sequence, go **OFF HOOK** using the front panel Hook Switch and the 930A will start sending when it gets a wink from the far end.

From this example you can see that it would be a very simple thing to change from the 3-stage to a 2-stage call at the output side of the Access Tandem. All you would have to do is clear out the old display and enter the new sequence with the IC code removed.

That is, the new sequence would be (Off-Hook supervision is left out):

WINK	CALLING #	CALLED #	WINK
W	**11**	**12**	**W**

You can use any memory locations you want. The principles remain the same.

The **SEND DIGIT SEQUENCES** Menu Option has been designed specifically to outpulse from the register locations where the digit strings are stored.

If the 930A is already **OFF-HOOK**, go back **ON-HOOK** and then go **OFF-HOOK** again and the sequence will be outpulsed. You will hear the outpulsing digit strings on the 930A's speaker and you should also hear the far-end answer. The Model 930A will also automatically time the winks. The wink timing can be examined by going to Menu Option 9: **WINK TIMING**. This Menu Option is discussed in Section 3-10.7.

You can either "send" a multi-wink sequence from the 930A or "receive" a multi-wink sequence (described in Section 4-2.4) but you cannot do both simultaneously from a single 930A. A single 930A cannot simulate the Originating and Terminating offices simultaneously.

NOTE:

Any modifications made in **MODIFY DIAL/RING** (Menu Option 1) will also be stored.

Make sure that the correct Trunk Type has been selected before storing any strings.

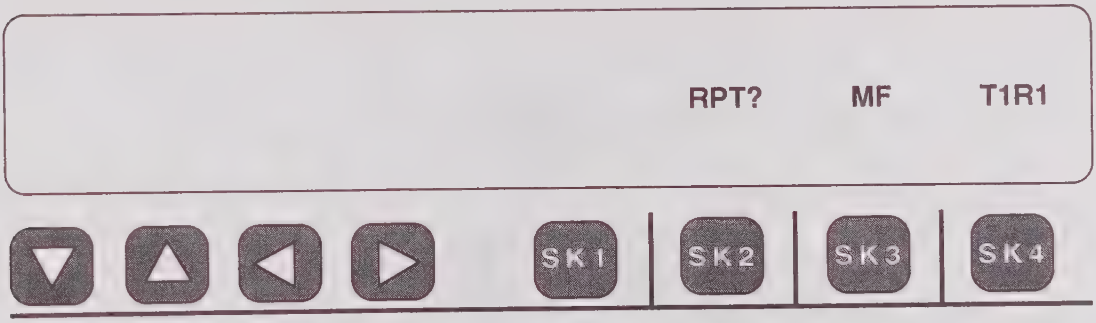
3-10.3.2 HOW TO PLACE A CALL ON A WINK START TRUNK

E&M or T-1 Carrier Interoffice Trunks are commonly Wink Start trunks. That is, the originating office will not send digits to the terminating end until it receives a wink from the terminating end office indicating that it is all right to proceed.

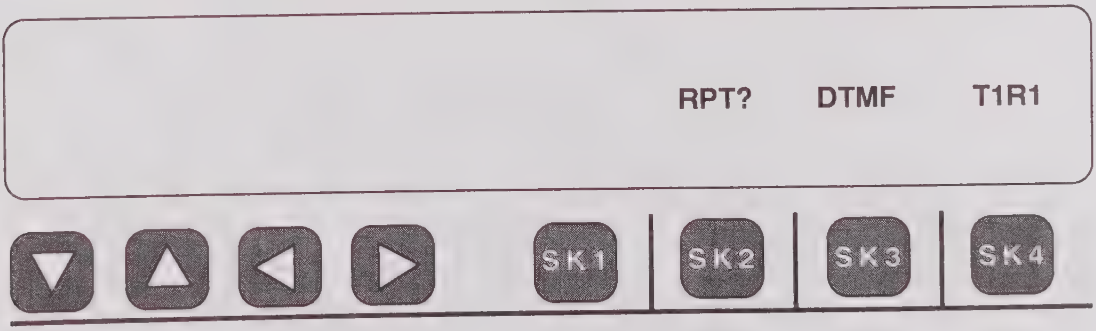
To examine the procedure for originating a Wink Start call, assume a **DTMF** sequence is to be sent. As in the previous example, it is necessary to first store the desired phone number in one of the memory locations (00 to 39) under the **DIAL/RING** function. To repeat the process:

Press the DIAL/RING function key.

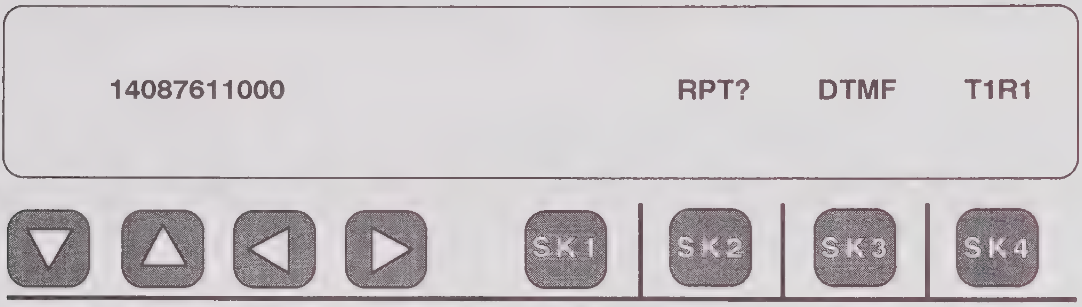
The 930A display below is a typical example:



To send the **DTMF** digits called for in this example, press Softkey 3 (under **MF**) and the display will change to:



Next, enter the telephone number you want to call using the keypad like a regular telephone. Make sure that the 930A is **ON HOOK**. After entering a number, a typical display is:



14087611000 RPT? DTMF T1R1

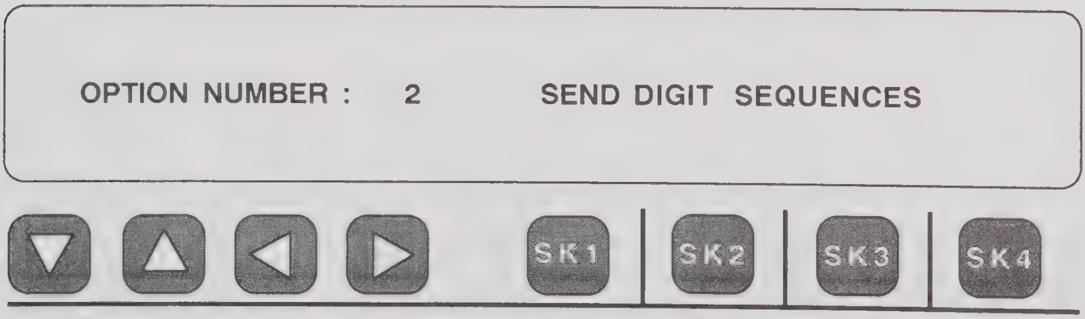
You use the same procedure employed in the Feature Group D example to store the number in, say, register location **20**. After you press the **STORE** key, enter **2** and **0** from the keypad, and press the **ENTER** key. The 930A display will return to the above display. At that point, just perform the following steps:

Press the OPTION MENU function key.

Use the UP/DOWN ▽ △ arrow keys to

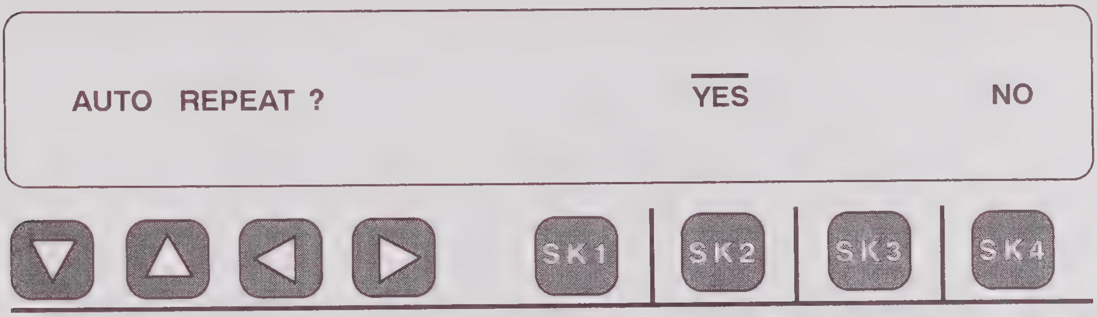
select Menu Option 2: SEND DIGIT SEQUENCES.

The 930A display should look like:



OPTION NUMBER : 2 SEND DIGIT SEQUENCES

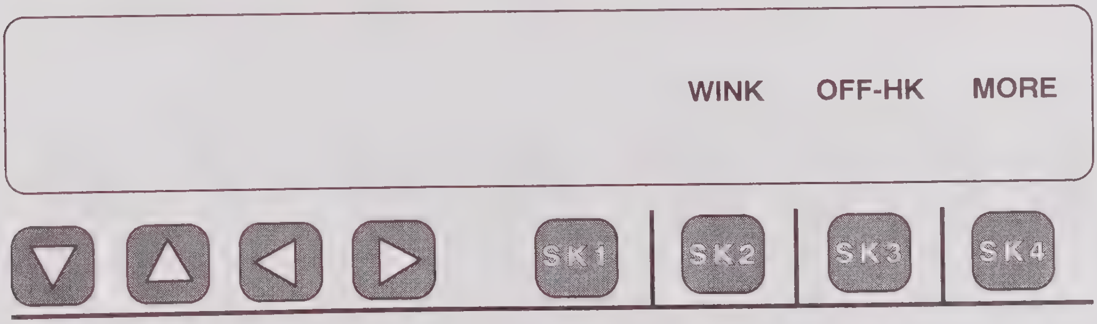
Press any softkey under the display to enter the Menu Option and the 930A display will change to:



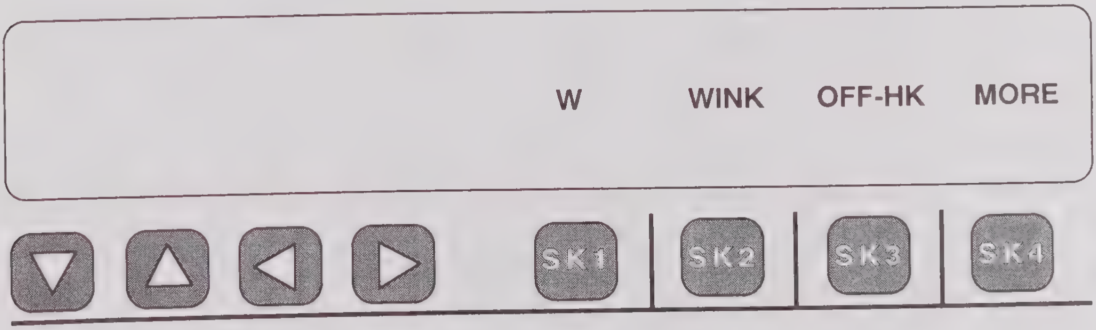
If you press Softkey 2 (under **YES**), the 930A will continuously repeat outpulsing the sequence after you go **OFF HOOK**.

If you press Softkey 4 (under **NO**), the 930A outpulses the sequence you enter once.

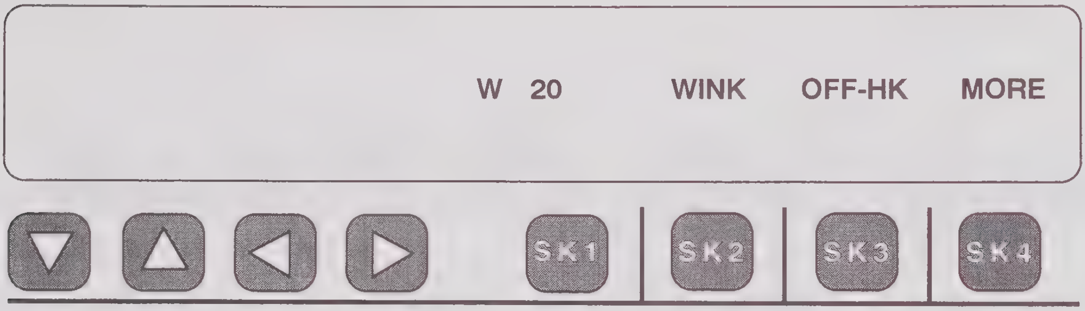
Pressing either softkey causes the 930A display to become:



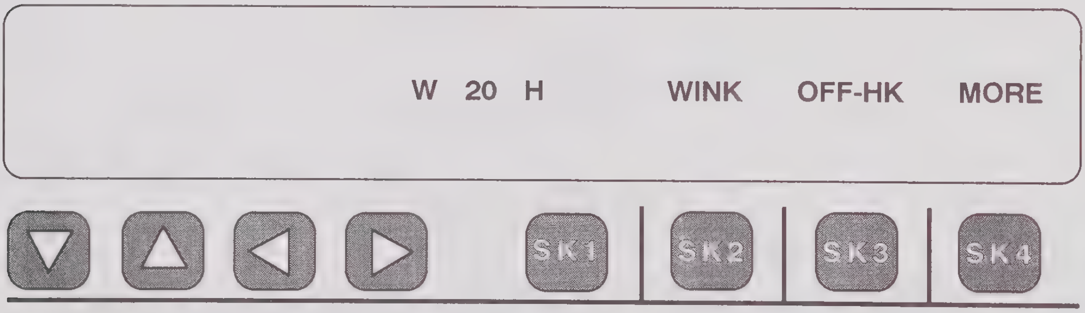
To program the 930A to wait for a wink before outpulsing, press Softkey 2 (under **WINK**) and the 930A display will become:



Next, enter the location of the memory register where the phone number to be outpulsed is located. In this example, the number to be outpulsed after the wink, was stored in memory location **20**. Press **2** and **0** on the numeric keypad, then press the **ENTER** key, and the 930A display will be:



An **OFF HOOK** indication can be inserted at the end of the sequence to look at answer back supervision. Press Softkey 3 (under **OFF-HK**) and the display will change to:



To outpulse the telephone number then, all that is required is to place the front panel hook switch in the **OFF HOOK** position and the 930A will seize the trunk, wait for a wink and then outpulse the digits after the wink.

3-10.3.3 HOW TO SEND A CALL MORE THAN 18 DIGITS LONG

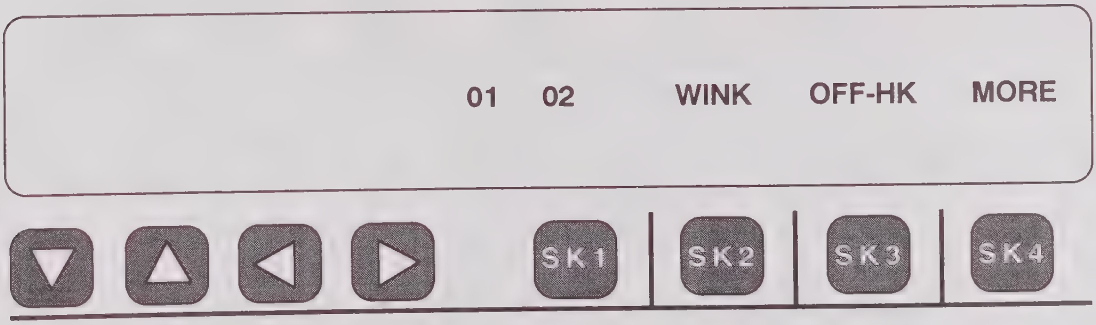
You may want to send a phone number longer than the 18 digit maximum permitted by the **DIAL/RING** function. This is another example of where Menu Option 2 comes in handy.

Suppose you want to send out a long string of digits as part of your manufacturing tests on a piece of your equipment. By now you have an idea of how the procedure works. First, you enter the number under **DIAL/RING**, then you store it in one of the 40 register locations, then you go to Menu Option 2 and enter the storage location, and finally you go Off Hook.

This situation is a little different because we cannot enter the entire number into the **DIAL/RING** display. How do we overcome this problem?

The first thing to do is start from an example. Suppose you wanted to send a string of thirty **DTMF** 6's for some reason. It could be anything but this will serve as an example. We know we can send 18 digits from **DIAL/RING** but what about the other twelve. Well, suppose we go to **DIAL/RING**, select **DTMF** mode, and enter eighteen 6's. Then we store this string in register 1, for example. Next, clear out this display and enter twelve 6's and store them in register 2. These could have been any mixture of numbers.

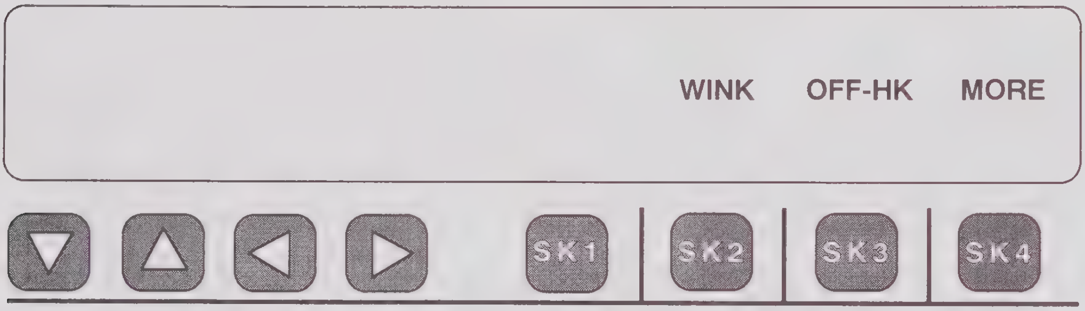
Go to the **SEND DIGIT SEQUENCES** menu and clear out any previous sequences. Then enter the number **1**, press **ENTER,** enter the number **2**, press **ENTER**, and the display will be:



Now, go **OFF HOOK** and the 930A will send the string of thirty **DTMF** 6's. From this, you can see that all you have to do to send up to 72 digits, is to store up to 18 digits in each of four successive memories (1, 2, 3 and 4 for example). You can also use this menu to send a mixture of **MF, DTMF or DP** digits.

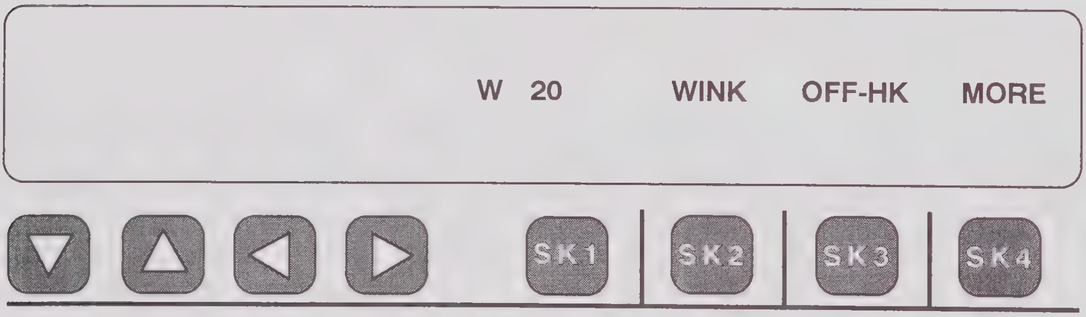
3-10.3.4 ADDITIONAL FEATURES OF MENU OPTION 2

By now, you are probably curious about what is under Softkey 4 (**MORE**) in these displays.

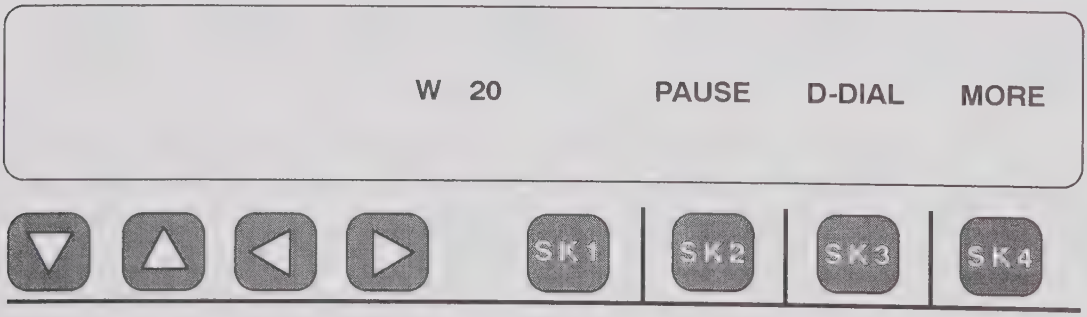


Instead of entering a **WINK**, or looking for an **OFF HOOK** at the end of the sequence, suppose you wanted to enter a pause instead. In this case, go back to the 930A display on page 3-88 before the **OFF HOOK** was entered.

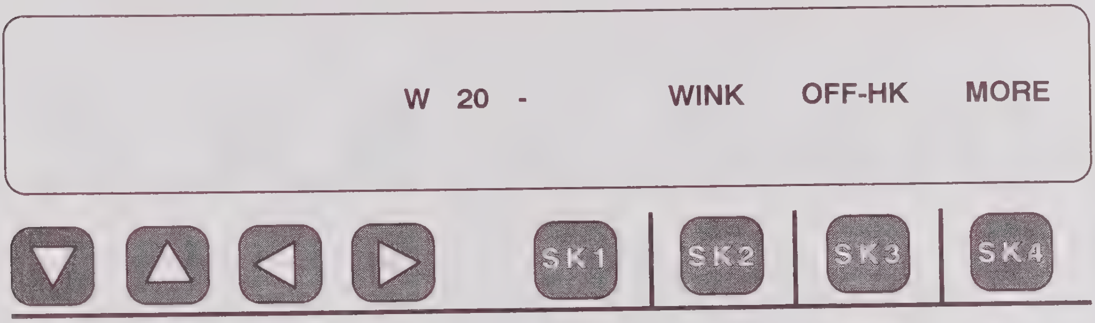
The display is repeated below:



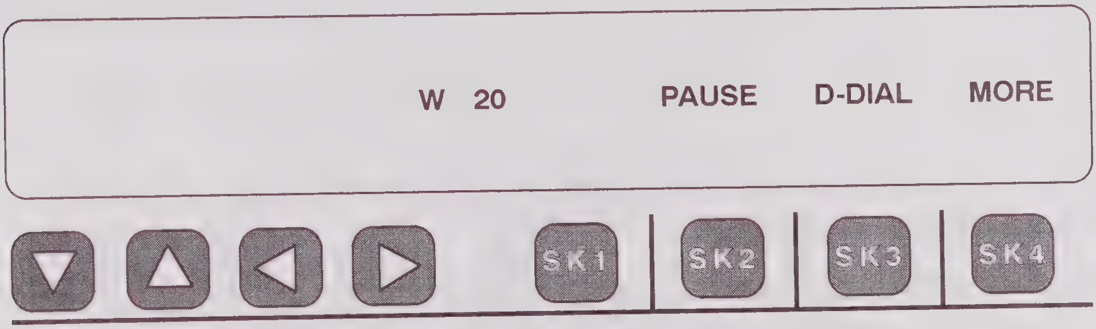
Instead of pressing Softkey 3, press Softkey 4 (under **MORE**) and the 930A display will advance to:



From this menu you can enter the Pause by pressing Softkey 2 (under **PAUSE**) and the 930A display will become:

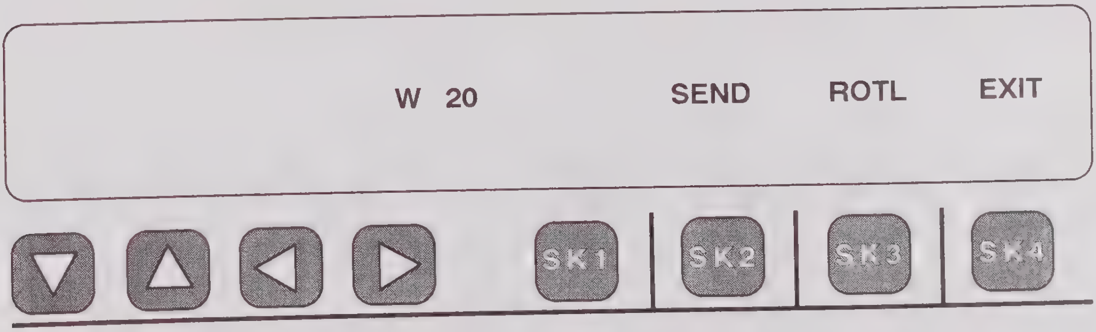


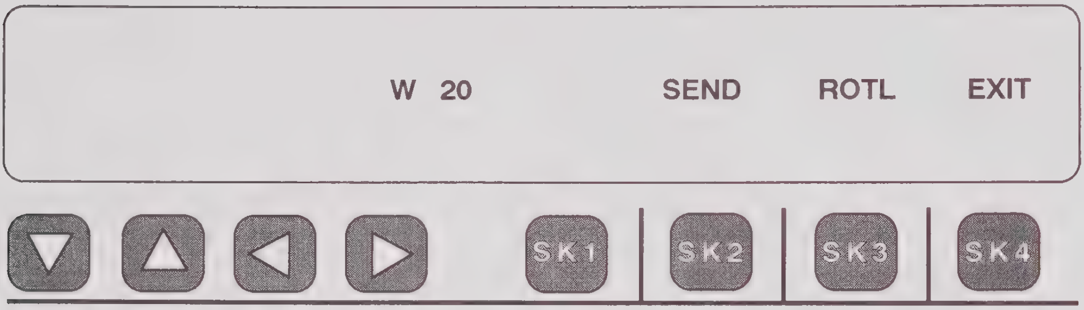
The digits stored in location **20** would be sent after going Off-Hook and receiving a wink. The 930A would then pause for one second after outpulsing.



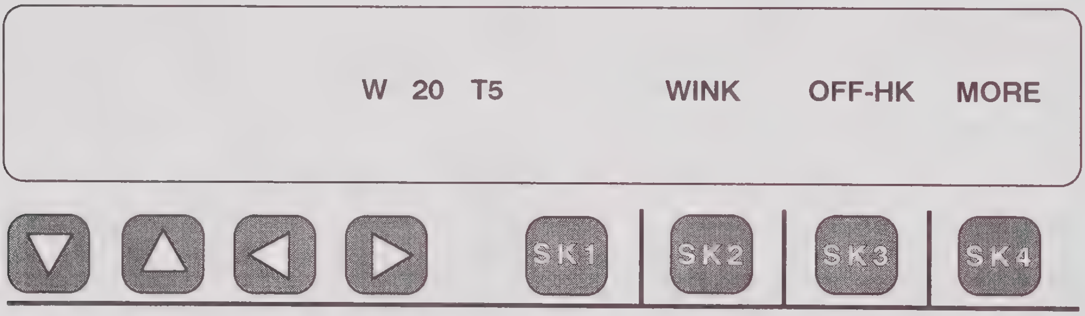
Instead of entering a **PAUSE**, a **DELAY-DIAL** event could be inserted by pressing Softkey 3.

Pressing Softkey 4 (under **MORE**) again, instead of entering a pause or delay-dial, would bring up the following choices:





Pressing Softkey 2 (under **SEND**) enables sending the sequence without first going **OFF HOOK**. **Pressing Softkey 3** (under **ROTL**) causes the 930A to act as a Remote Office Test Line (ROTL)/Near End Responder at the end of the sequence. Purchased Options 930A-01 and -12 are required for this to function. The display in this case looks like:



When the 930A goes OFF-HOOK, the number of the far-end test line will be outpulsed after the Wink is received. When the call completes, and the Test Line answers with the Test Progress Tones, the 930A will begin testing. The results of the 2-way measurements will be displayed. The results are stored in memory and you can review them in Menu Option 26. The operation of the ROTL/Responder option (Option 930A-12) is explained in greater detail in Section 4-6.2.1 since it is a purchased option.

3-10.4 HOW TO USE THE DC VOLT/AMP METER (MENU OPTION 6)

Menu Option 6: **DC VOLT/AMP METER** provides you with a DC voltage and current measuring capability on metallic (analog) trunks. This function is most useful for determining the levels of supervision voltages and currents on a loop.

You can measure the DC voltage from Tip-to-Ground, Ring-to-Ground, and Ring-to-Tip **on 2-wire Loop and 2-wire Ground-Start trunks**. The DC voltage from TR-to-Ground, T1R1-to-Ground and TR-to-T1R1 may be measured **on 4-wire Loop and 4-wire Ground-Start trunks**. **On E&M trunks**, you can measure the DC voltage from E-to-Ground and M-to-Ground. All voltage readings are printed as signed values to the nearest volt. This feature may be used in either **TERM** or **BRIDGE** mode. You can **measure DC current on 2- and 4-wire Loop and Ground Start trunks** when the 930A is set to the **CONTACT** mode and terminates the trunk.

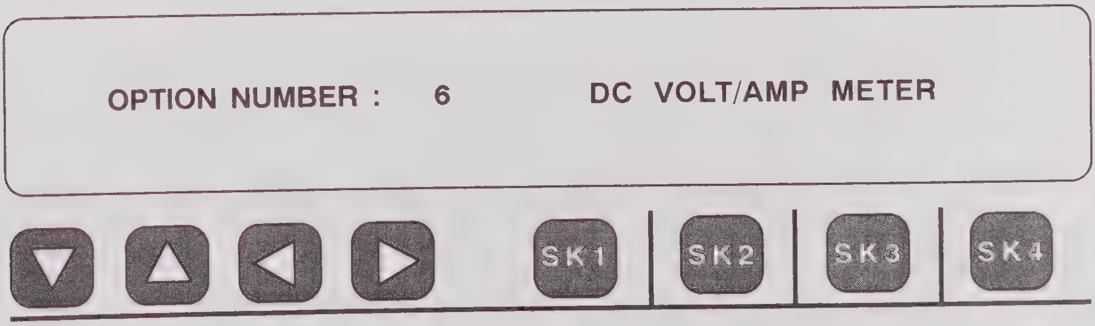
To measure DC voltage or current on a 2-wire Loop Start trunk:

Press the OPTION MENU ■ ○ **Option Menu** function key.

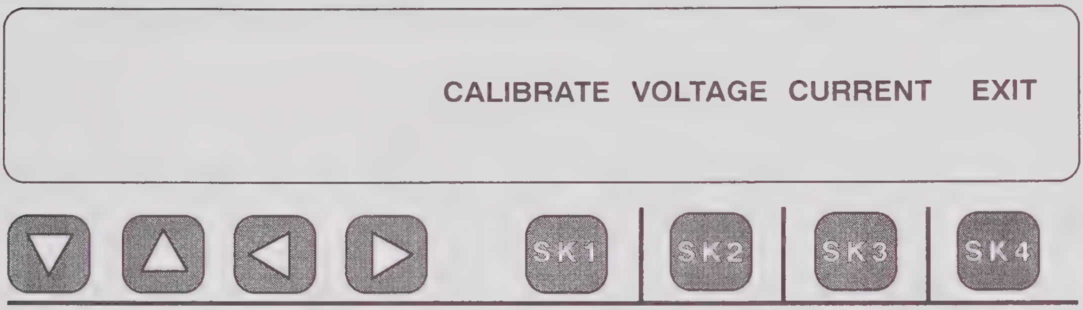
Use the UP/DOWN ▽ △ arrow keys to

select Menu Option 6: DC VOLT/AMP METER.

The 930A display will be:

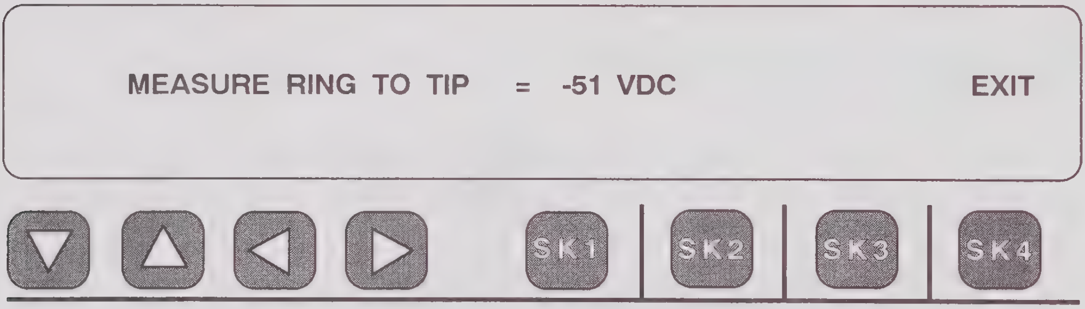


OPTION NUMBER : 6 DC VOLT/AMP METER



Press the softkey under the measurement you wish to make, or press Softkey 1 under **CALIBRATE** to make the 930A calibrate itself prior to making a measurement. Press **CALIBRATE** prior to any current measurements.

To measure DC Voltage, press Softkey 2 under **VOLTAGE** and you will see a display similar to:

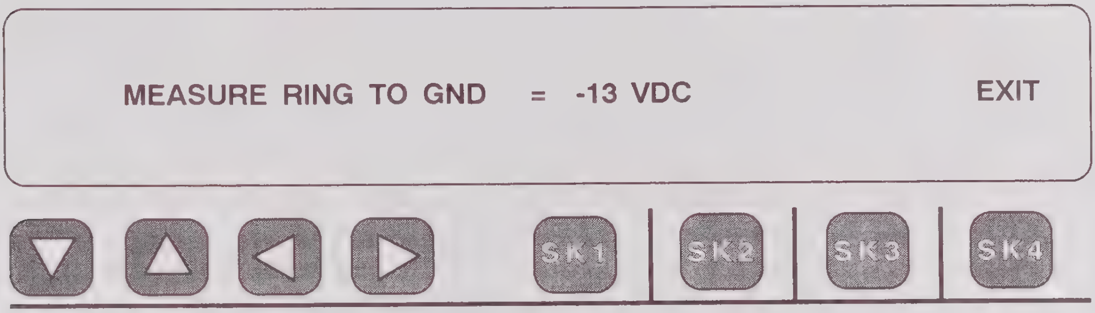


In this case, the contact side of the circuit is **ON HOOK** because the voltage is high. If the contact side goes **OFF HOOK** then a lower reading will be expected as current is drawn through the loop and voltage drops occur. A typical Ring-to-Tip voltage, after the contact side goes **OFF HOOK**, might be less than -45 volts.

If no drop had occurred, this would indicate an open loop. Further checking along the circuit path would be required to determine the source of the open.

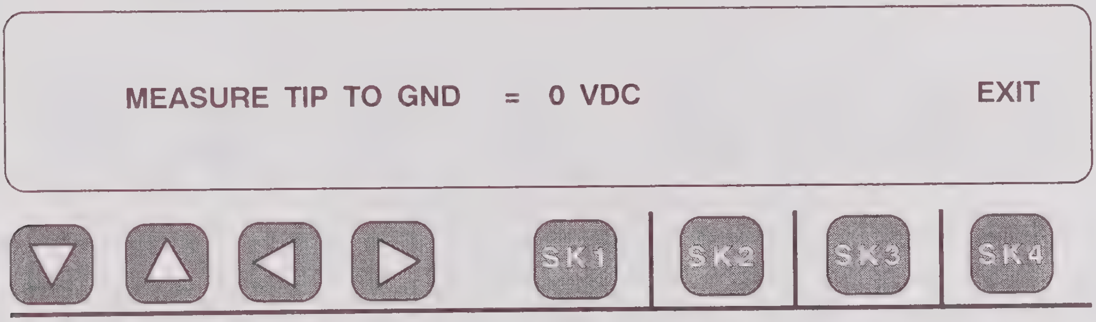
To measure the voltages from Ring-to-Ground and Tip-to-Ground under **ON** and **OFF HOOK** states, press Softkey 1 and the display will scroll to the next state.

An example of a typical Ring-to-Ground measurement if the contact side goes **OFF HOOK** is shown below:



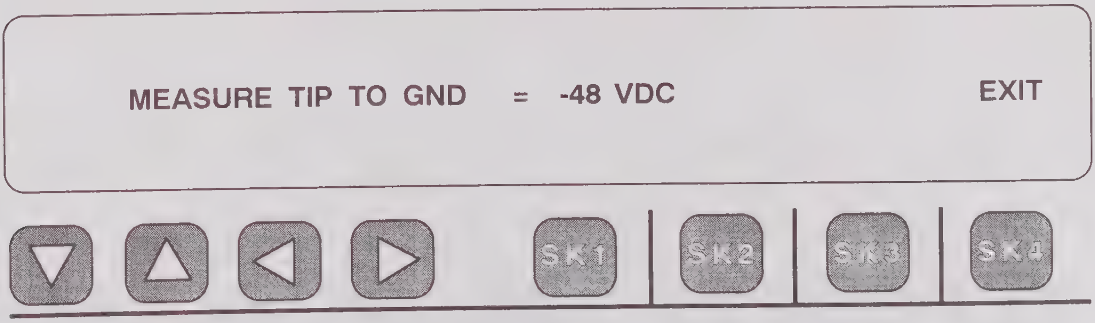
MEASURE RING TO GND = -13 VDC EXIT

Pressing Softkey 1 advances the 930A to measuring the Tip-to-Ground voltages. An idle state (both sides **ON HOOK**) should give the following display:



MEASURE TIP TO GND = 0 VDC EXIT

This is the proper indication for a Loop Start trunk in the idle state. When the battery side goes **OFF HOOK**, a typical display of Tip-to-Ground voltage would be:



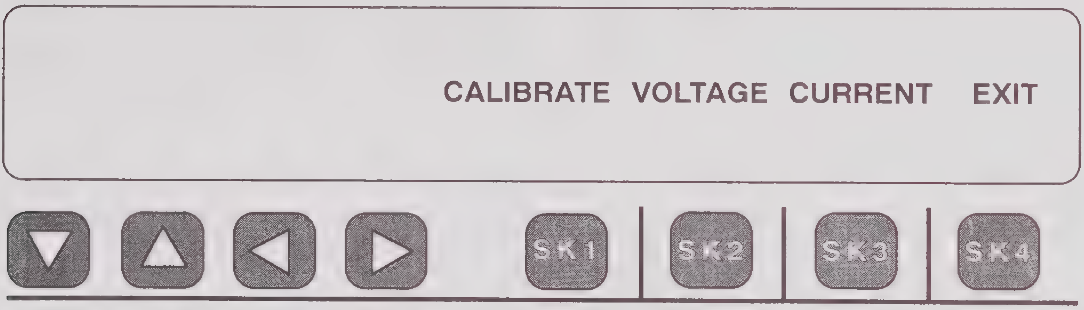
MEASURE TIP TO GND = -48 VDC EXIT

This indicates a battery reversal. Unless these or similar readings were obtained, there would be an indication of trouble in the loop supervision circuitry. Press Softkey 4 under **EXIT** to return to the main menu.

The following table lists the range and accuracy of the various 2-wire and 4-wire DC Voltage measurements the 930A can make.

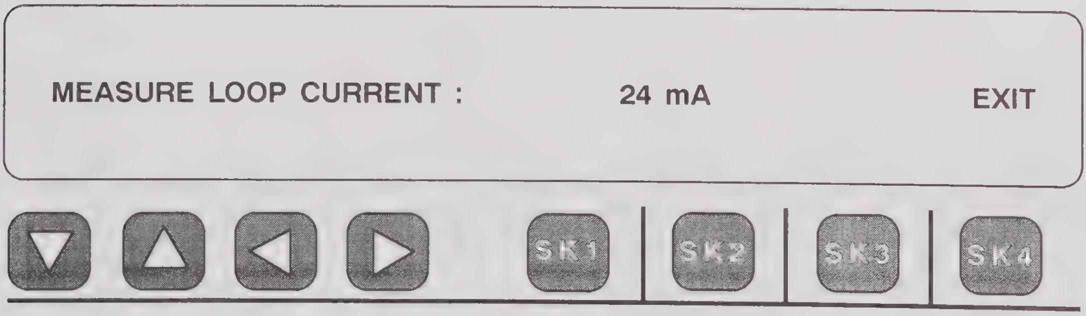
	RANGE	**ACCURACY**
Tip-to-Ring and **TR-to-T1R1:**	+60.0 to -60.0	+/- 1 volt
Tip-to-Ground and **Ring-to-Ground:**	+0.0 to -60.0	+/- 1 volt
TR-to-Ground and **T1R1-to-Ground:**	+0.0 to -60.0	+/- 1 volt
M-to-Ground and **E-to-Ground:**	+0.0 to -100.0	+/- 1 volt

NOTE: Refer to Section 3-10.5 **SUPERVISION THRESHOLDS**, for a description of the expected voltage levels and 930A supervision.



To measure DC current, the 930A Trunk Type must be set for 2- or 4-wire Loop or Ground Start, CONTACT and Terminate operation. Prior to measuring the current, you should remove the test cords from the 930A and press Softkey 1 under **CALIBRATE** in the main menu shown above. After calibrating the 930A you may then reconnect the test cords.

Press Softkey 3 under **CURRENT** in the main menu and the loop current measurement will be displayed. A typical display would look like:


MEASURE LOOP CURRENT : 24 mA

Error messages are provided if you try to measure a parameter without having the Trunk Type correctly set up.

3-10.5 HOW TO CHANGE THE SUPERVISION VOLTAGE THRESHOLDS (MENU OPTION 7)

The 930A was designed to send and receive -48 VDC supervision which is the most common form. That is, **ON HOOK** or **OFF HOOK** supervision status on Loop Start, Ground Start, or E&M trunks is represented by a voltage level between 0 and -48 VDC. For example, an **ON HOOK** state might be -48 VDC while an **OFF HOOK** state might be -30 VDC. This happens because the **On Hook** state is an open loop or idle condition with no load and no voltage drops, while the **Off Hook** condition is a closed loop with current being drawn, and consequently lower voltage.

At the end of very long loops, or when you are working on systems powered from -24 VDC, you may need to change the threshold voltage settings on the 930A in order to make the front panel supervision LEDs function properly, and to allow functions like the Digit Receiver/Analyzer (Option 930A-01) to operate. This is the purpose of Menu Option 7.

IMPORTANT NOTE

> You can only change the threshold of the voltage which the 930A will recognize at its input. You cannot change the level of the supervision voltage which the 930A supplies at its output. This is fixed at 48 volts.

If you are unsure of the levels on your trunk you should first measure the voltage levels of the **ON** and **OFF HOOK** states using Menu Option 6: **DC VOLTMETER**. Once you have determined what the voltages are you can go to Menu Option 7 and reset your thresholds accordingly.

Usually the tip off that you need to change thresholds comes from the front panel supervision LEDs. These may flicker, or they may not be lit at all, if the proper voltages are not present. If you have selected the correct trunk type for the 930A and connected it to the trunk under test and the LEDs do not indicate properly, then you should check the voltages on the trunk with the DC Voltmeter.

Some understanding of trunk supervision circuits is necessary to make use of this feature successfully. It is **not** normally necessary to use this Menu Option when operating the 930A.

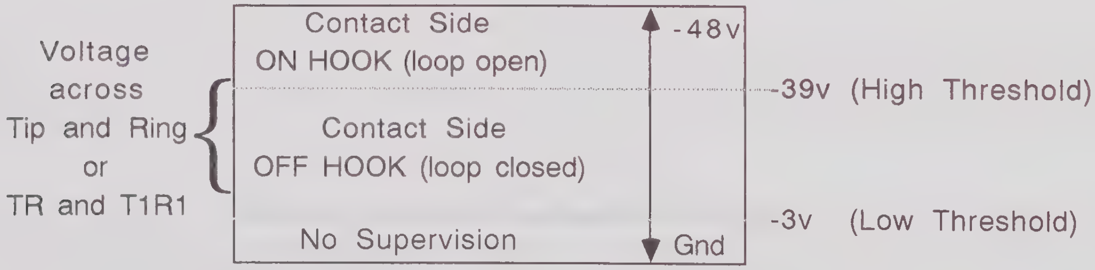
The choices presented in this Menu Option will vary, depending upon the current trunk type, and which end of the circuit the 930A is on. In all cases however, a series of screens are presented showing a voltage level, a description of the supervision state this represents, and a **DEFAULT** choice. To change the displayed level, enter a new value using the numeric keypad. To select the default level, press the softkey labeled **DEFAULT**. To accept the currently displayed value, press any other softkey. Once all the thresholds have been set, the 930A will return to the Option Menu display.

In all cases, "**ORIG**" refers to the end of the circuit the 930A is on. If the 930A trunk type is set to Loop Contact, for example, **"ORIG OFF HOOK"** means the contact side of the circuit is Off Hook. If the 930A is providing battery, **"ORIG OFF HOOK"** means the battery side of the circuit is Off Hook. Voltage levels are printed as absolute values: **"< 45V"** does **not** mean "more negative than -45 Volts;" it means "less than 45 Volts of potential." Values can be set to the nearest volt with an accuracy of +/- 0.5 VDC. Use Menu Option 06: **DC VOLTMETER** to examine the current voltage levels.

3-10.5.1 SUPERVISION THRESHOLD RANGES

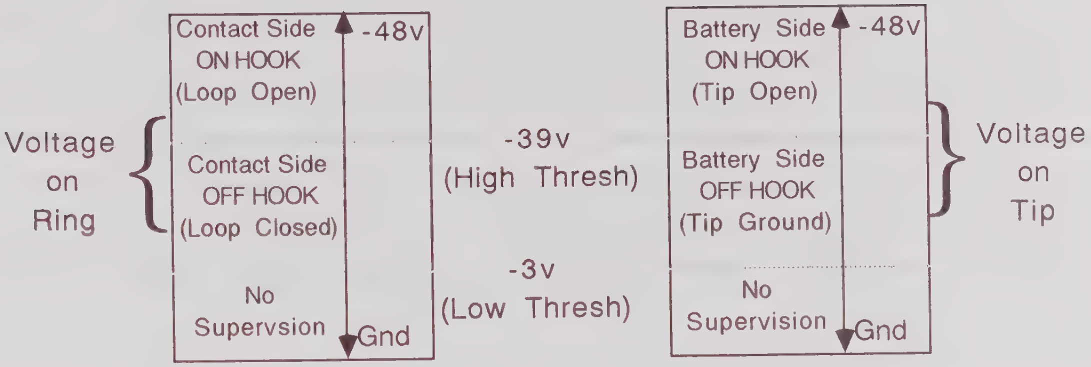
This section provides a graphic presentation of the various supervision threshold ranges and their corresponding indications.

LOOP START SUPERVISION


Voltage across Tip and Ring or TR and T1R1
Contact Side ON HOOK (loop open)
-48v
-39v (High Threshold)
Contact Side OFF HOOK (loop closed)
-3v (Low Threshold)
No Supervision
Gnd

This shows the **ON** and **OFF HOOK** indication states of the supervision LEDs for the default setting of Ring-to-Tip voltage thresholds. Voltages above 39 volts will cause an **ON HOOK,** and voltages above 3 VDC and below 39 VDC will cause an **OFF HOOK**. A reversal of -48 Volts and ground would indicate the battery side **OFF HOOK**.

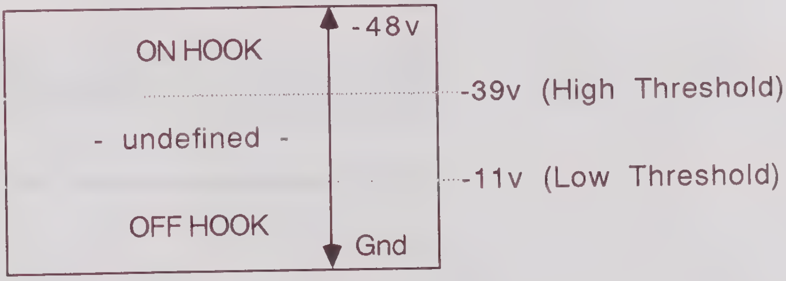
GROUND START SUPERVISION


Voltage on Ring
Contact Side ON HOOK (Loop Open)
Contact Side OFF HOOK (Loop Closed)
No Supervsion
-48v
Gnd
-39v (High Thresh)
-3v (Low Thresh)
Battery Side ON HOOK (Tip Open)
Battery Side OFF HOOK (Tip Ground)
No Supervision
-48v
Gnd
Voltage on Tip

This provides a description of the **ON** and **OFF HOOK** supervision states at each end of a Ground Start circuit with the default thresholds. Voltages on Ring above 39 Volts indicate **ON HOOK** at the **CONTACT** side. Voltages on Tip in excess of 39 Volts indicate **ON HOOK** on the **BATTERY** side.

E&M SUPERVISION

Originating end (**SEND-M**) indications:



Here, the **ORIG** LED shows the status of the M-Lead. The **TERM** LED shows E-Lead status. An **OFF HOOK** indication is provided if the voltage is below 11 Volts. The LEDs will not be lit for voltages below 39 Volts but above 11 Volts. The LEDs show an **ON HOOK** if the voltage is greater than 39 Volts.

Terminating end (**SEND-E**) indications (use the same diagram above):

In this case, the **ORIG** LED shows the status of the E-Lead. The **TERM** LED shows M-Lead status. The LEDs do not light for voltages below 39 Volts and above 11 Volts. The LEDs will indicate an **OFF HOOK** if the voltage is below 11 Volts. The LEDs will indicate an **ON HOOK** for a voltage above 39 Volts.

3-10.5.2 HOW TO WORK WITH 24 VOLT SUPERVISION

Rather than try to explain, in general terms, how to change supervision thresholds, it will be more useful to take the most common reason for changing them from their defaults, and give examples for each trunk type. The following sections outline the procedure for setting Loop Start, Ground Start and E&M trunk supervision thresholds to accommodate 24 VDC supervision instead of the normal 48 volts.

3-10.5.3 HOW TO CHANGE LOOP SUPERVISION THRESHOLDS

To look at dialed digits on a 2-wire Loop Start PBX trunk which uses 24 VDC supervision, you will need to use Menu Option 7. The following example will give you an idea of how this Menu Option works.

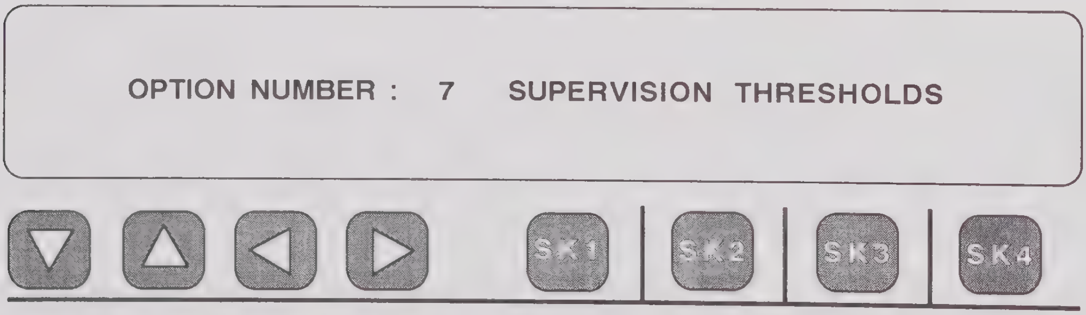
After setting the 930A to **LOOP NORMAL** Trunk Type, and simulating a 2-wire, 600 or 900 ohm circuit's originating (**CONTACT**) end, perform the following steps to adjust the supervision thresholds.

Press the OPTION MENU ■ ○ **Option Menu** function key.

Use the UP/DOWN ▽ △ arrow keys to

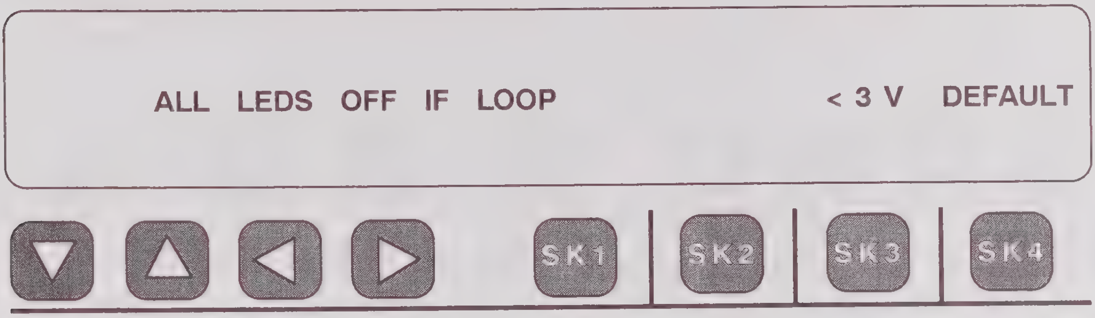
select Menu Option 07: SUPERVISION THRESHOLDS.

The 930A display will appear as shown below:



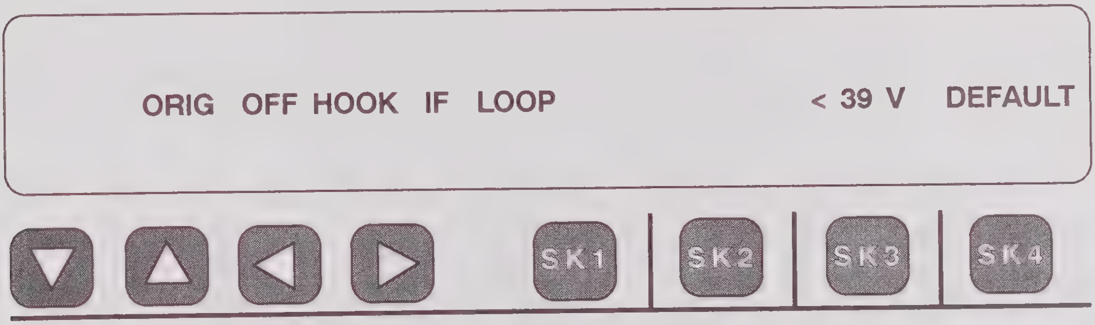
OPTION NUMBER : 7 SUPERVISION THRESHOLDS

Press any softkey to enter the menu option and the display will appear as:



ALL LEDS OFF IF LOOP < 3 V DEFAULT

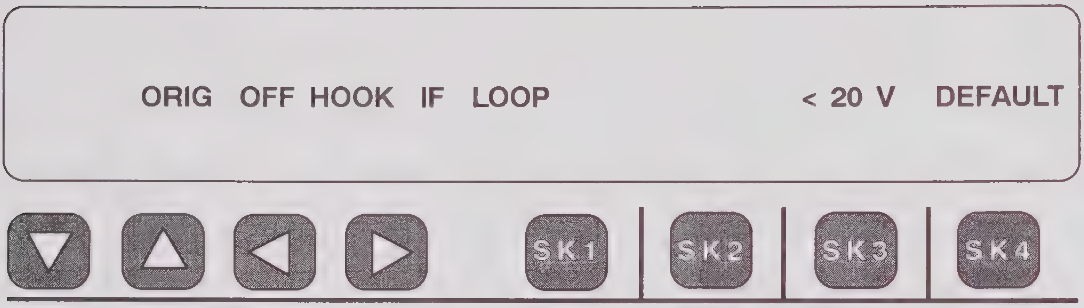
The display above means that if there is no talk battery present ("Dry" loop), there will be no voltage across the loop, and the 930A will turn off all supervision LEDs. This threshold is preset at 3 Volts. For this example, this value will be adequate. Advance the display to the next choice by pressing either Softkey 1, 2, or 3 to bring up:



ORIG OFF HOOK IF LOOP < 39 V DEFAULT

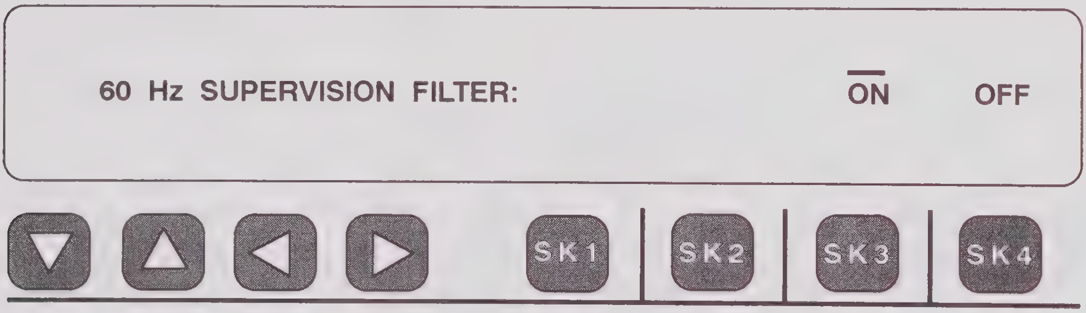
When the originate, or **CONTACT**, side of the circuit goes **OFF HOOK**, it closes the loop between Tip and Ring (2-wire) or TR and T1R1 (4-wire). This lowers the voltage difference across the loop. On a short loop, or near the contact end of the circuit, this voltage will be very small. Near the battery (Central Office) end on a long loop, this voltage can remain fairly large. The 930A sees the **CONTACT** end as being **OFF HOOK** when the voltage across the loop falls below 39 Volts. If a PBX is being tested and it is powered from -24 Volts instead of -48 Volts, then the threshold of the 930A should be set to about 20 Volts.

To set the threshold to 20 Volts, use the keypad to enter the number **20**, and press the **ENTER** key. This value will now be remembered by the 930A so you will have to press the **DEFAULT** key, in the above display, when you have finished testing, or you will encounter strange readings when you go back to normal 48 Volt trunks.

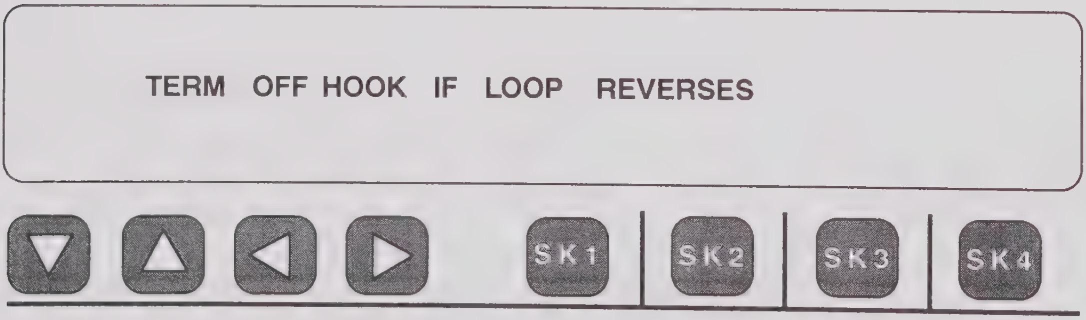

ORIG OFF HOOK IF LOOP < 20 V DEFAULT

After you have set in the 20 Volt level, press the **OPTION MENU** function key to exit from this menu.

IMPORTANT NOTE: If you press either Softkey 1, 2, or 3 instead of pressing the **OPTION MENU** key and exiting, you will be asked to select whether you want the 60 Hz filter on or off. Most times, the answer is **ON**. You turn the filter **ON** and this is the default. However, if you are receiving Dial Pulse digits, then you would turn this filter **OFF**. The display is:


60 Hz SUPERVISION FILTER: $\overline{\text{ON}}$ OFF

If you had set the Trunk Type to simulate the Central Office, or **BATTERY** end of the circuit, the only difference in the procedure would be that the display below would have appeared as a reminder


TERM OFF HOOK IF LOOP REVERSES

and the threshold display would read **TERM OFF HOOK IF LOOP <39 V**. The procedure for changing the threshold to 20 volts would be the same.

The previous display explains that the 930A expects the **BATTERY** (Central Office) side of a loop start circuit to provide -48 VDC on Ring (**2-wire**) or T1R1 (**4-wire**) in **NORMAL** mode. In **LOOP REVERSE**, the 930A expects to see -48 VDC on Tip (2-wire) or TR (4-wire). The 930A interprets this as the normal **ON HOOK** condition. A reversal from - to + is interpreted as the **BATTERY** side of the circuit being **OFF HOOK**. There is no voltage threshold.

Essentially, Menu Option 7 enables you to adjust the supervision voltages so the front panel LED supervision indicators will read properly under unusual circumstances.

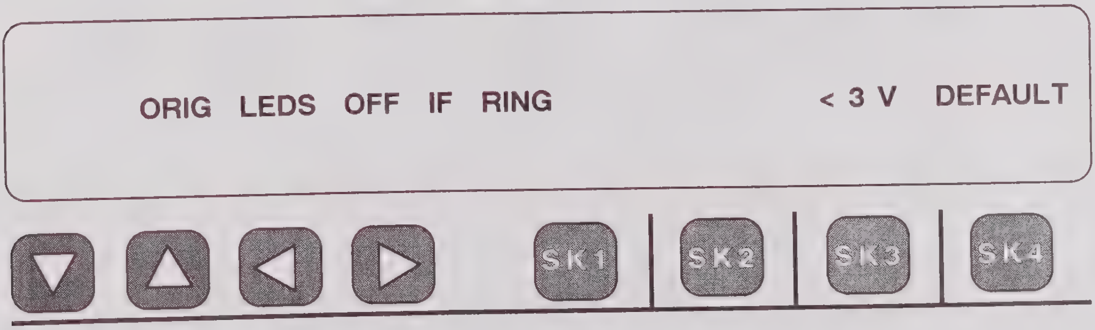
IT DOES NOT MEAN THAT THE 930A WILL OUTPUT OTHER THAN -48 VDC SUPERVISION, MERELY THAT IT WILL RECOGNIZE OTHER VOLTAGES AT ITS INPUT.

3-10.5.4 HOW TO CHANGE GROUND START THRESHOLDS

For this example assume a 2-wire 900 ohm, NORMAL Ground Start trunk type has been selected on the 930A. Further assume that the 930A is in **CONTACT** mode simulating the originating end of the circuit.

The following describes normal 2-wire trunks. For REVERSE circuits, Tip and Ring are interchanged. On 4-wire circuits, TR replaces Tip and T1R1 replaces Ring.

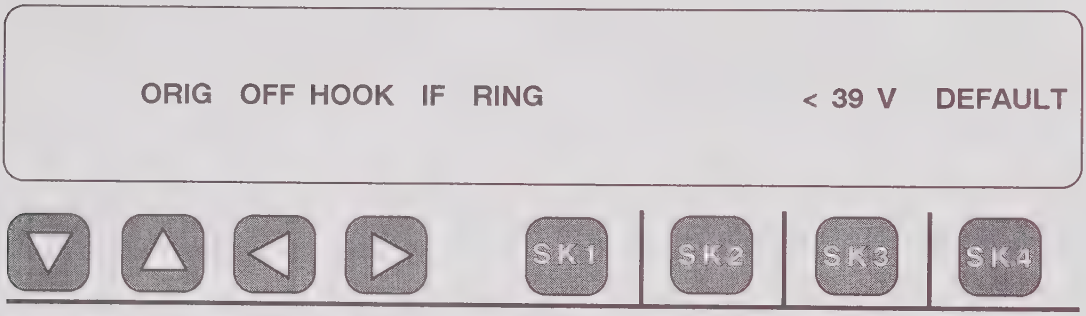
After selecting Menu Option 7 and pressing a softkey to enter the menu as previously described in Section 3-10.5.3, the 930A display will be:



```
ORIG LEDS OFF IF RING          < 3 V   DEFAULT
```

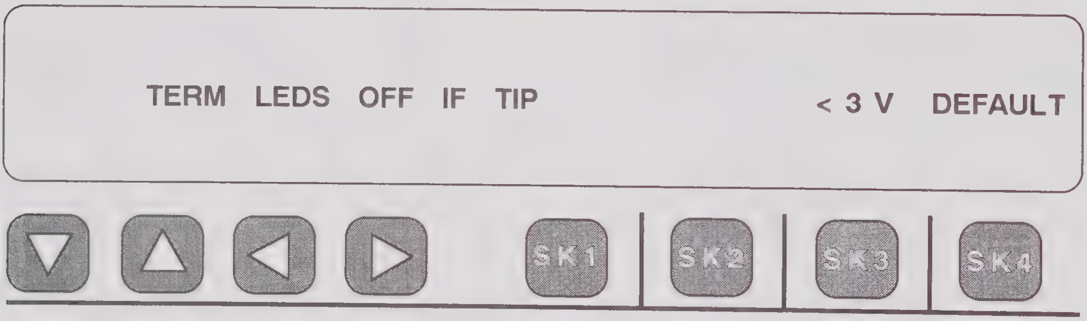
As before, this display explains that if there is no talk battery detected, there will be no voltage on Ring and the 930A will turn off the supervision LEDs on the contact side. The preset voltage threshold is 3 Volts. If you wanted to change this value you could simply enter the desired number from the numeric keypad and press the **ENTER** key. For our purposes, however, the default value of 3 volts is acceptable without change.

Pressing Softkey 1, 2 or 3 will advance the display to:



ORIG OFF HOOK IF RING < 39 V DEFAULT

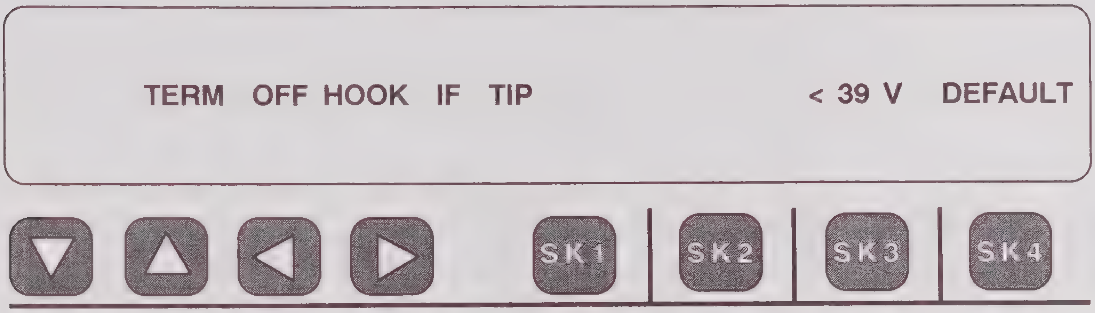
When the contact side goes **OFF HOOK**, it places ground on Ring or provides loop after the battery side has grounded Tip. In either case, the voltage on Ring goes toward ground. The preset default threshold is 39 Volts, as shown above. If the circuit is a -24 Volt system, the threshold should probably be set to about 20 Volts. Enter 2 and 0 and press **ENTER**. Press Softkey 1, 2, or 3 and the screen will advance to:



TERM LEDS OFF IF TIP < 3 V DEFAULT

If there is no high impedance supervision battery on Tip, or a loop condition exists and there is no talk battery on Ring, there will be no voltage present on Tip and the 930A will turn off the supervision LEDs on the battery side. The factory set default is 3 Volts, as shown above. The value may be changed by entering the desired value from the numeric keypad and then pressing the **ENTER** key. For this example this value is acceptable as is.

Press Softkey 1, 2, or 3 and the 930A display will advance to:



When the battery side goes **OFF HOOK**, or connects a digit receiver, it grounds Tip and the voltage on Tip goes toward ground. The default threshold is 39 Volts, as shown above. We want to change this value to 20 Volts in this example. Enter **2** and **0** from the numeric keypad and then press **ENTER**. Press the **OPTION MENU** key to exit from this menu.

The 930A is now set to receive 24 Volt supervision.

REMEMBER

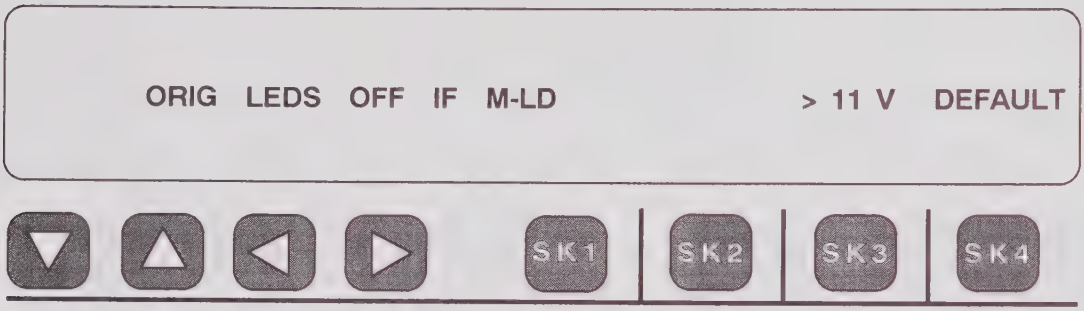
> You must return to these displays after you are finished testing and reset them to their default values to avoid problems on normal circuits. A **"Cold Boot"** will also restore the defaults.

3-10.5.5 HOW TO CHANGE E&M SUPERVISION THRESHOLDS

The various E&M Types (1 through 5) have different means of providing supervision battery to the **E** and **M** leads but the end result is the same. In one supervision state the lead is held at -48 Volts. In the other state it is held close to ground. The intermediate voltages are interpreted as "no indication" and the 930A turns off the appropriate LEDs.

For this example the 930A is assumed to be set to 4-wire, E&M Type I, SEND-M operation with a 24 VDC supervision trunk instead of the normal 48 VDC.

Upon entering Menu Option 7, the 930A display will be:

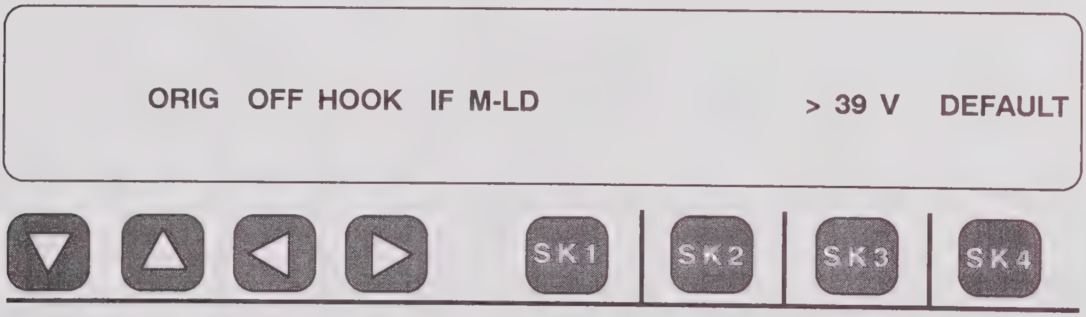


ORIG LEDS OFF IF M-LD > 11 V DEFAULT

This display shows the default value which will turn off the originating supervision LEDs if the **M** Lead voltage is greater than 11 Volts but less than the **OFF HOOK** threshold.

Since 24 volts is half of 48 volts, a good guess is to reduce everything displayed by half. So instead of 11 volts we enter 6, which is roughly half, using the keypad and the **ENTER** key as previously described.

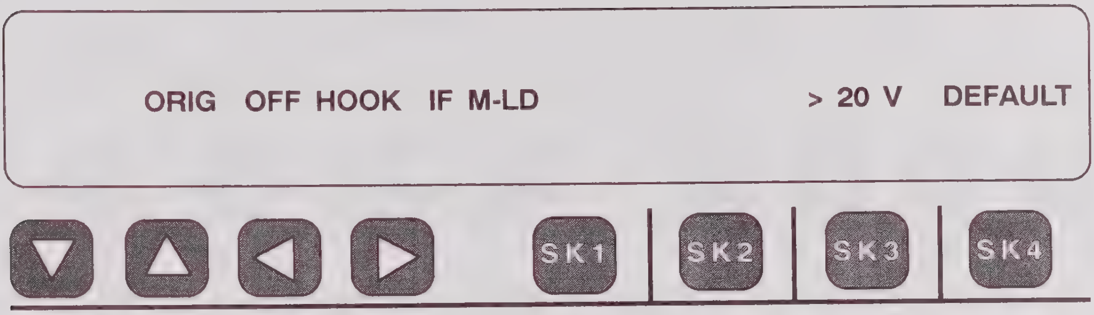
Next press either Softkey 1, 2, or 3 and the display advances to:



ORIG OFF HOOK IF M-LD > 39 V DEFAULT

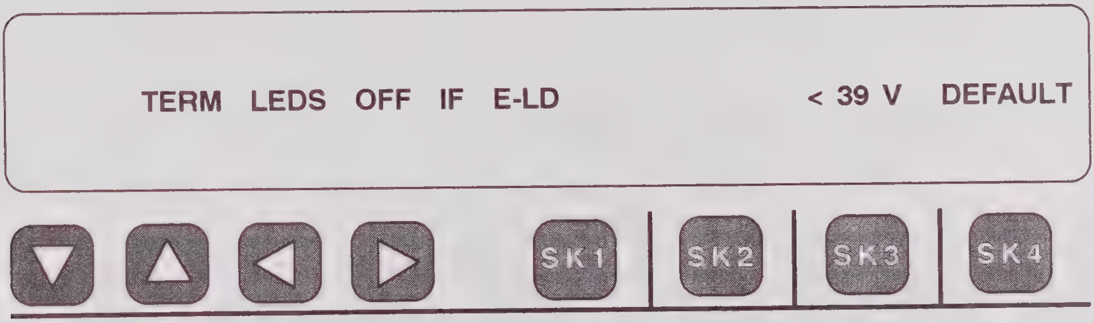
In this case the 930A will provide an **OFF HOOK** indication on the Originating LEDs if the voltage on the **M** Lead exceeds the 39 Volt threshold. This value has to be changed to 20 Volts (roughly half of 48). This is accomplished the same way by entering **2** and **0** and then pressing the **ENTER** key.

The 930A display now looks like:



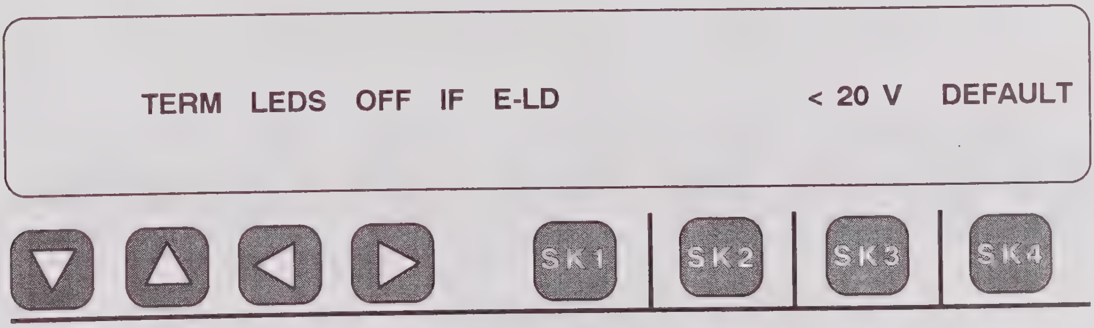
ORIG OFF HOOK IF M-LD > 20 V DEFAULT

Pressing Softkey 1, 2, or 3 will advance the display to:



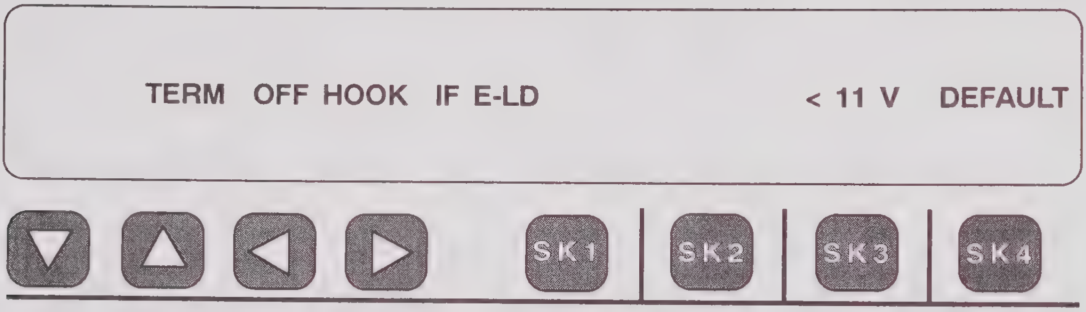
TERM LEDS OFF IF E-LD < 39 V DEFAULT

Here the 930A will provide no supervision indication if the voltage on the **E** Lead is below the high threshold of 39 Volts but above the low threshold of 11 Volts. The high threshold can be changed to 20 Volts as before and the 930A display will change to:

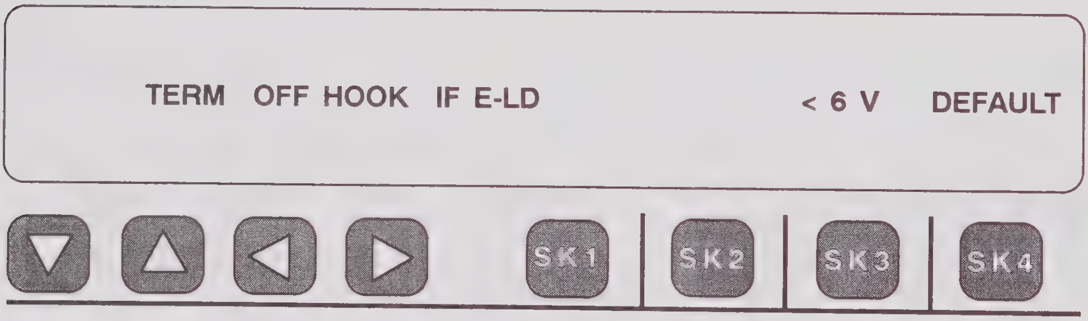


TERM LEDS OFF IF E-LD < 20 V DEFAULT

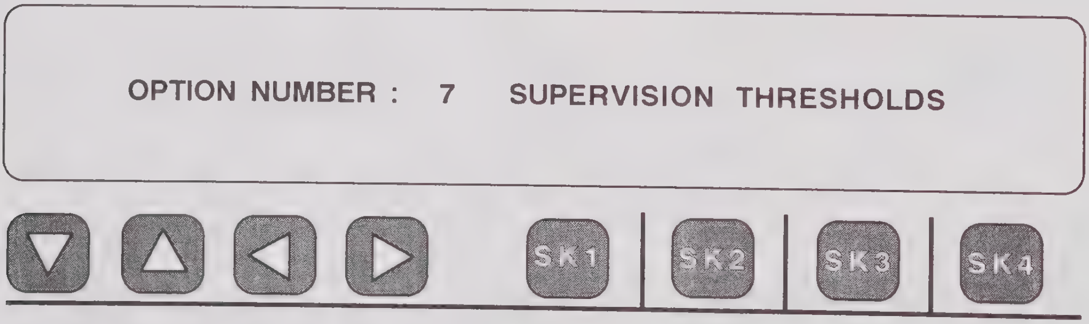
Pressing Softkey 1, 2, or 3 advances the display to the one shown on the following page.


TERM OFF HOOK IF E-LD < 11 V DEFAULT

An **Off Hook** indication on the front panel LEDs will be provided if the voltage on the **E** Lead is below the 11 Volt low threshold. This value must be changed to 6 volts in the same manner as the others which would make the display appear as:


TERM OFF HOOK IF E-LD < 6 V DEFAULT

When the thresholds have all been set, press the **OPTION MENU** key to return to the Option Menu 7 display repeated below:


OPTION NUMBER : 7 SUPERVISION THRESHOLDS

REMEMBER

You must return to these displays after you are finished testing and reset them to their default values to avoid problems on normal circuits. A **"Cold Boot"** will also restore the defaults.

3-10.6 MEASURING SUPERVISION EVENT TIMES (MENU OPTION 8)

Menu Option 8: **SUPERVISION MONITOR** gives the Model 930A the equivalent of a "strip chart recorder" function for timing events of long duration as well as for timing supervision events such as guard times, ground start timing and other events not covered by Menu Option 9: **WINK TIMING**.

This Menu Option will work on analog, as well as T-1 PCM, trunks with the 930A terminating the circuit or monitoring it (**Bridged** on analog trunks and **MONITOR** mode on PCM). The following paragraphs will give you a general idea of how this menu functions. This is followed by specific examples of measurements on ground start trunks and the optional PCM trunks.

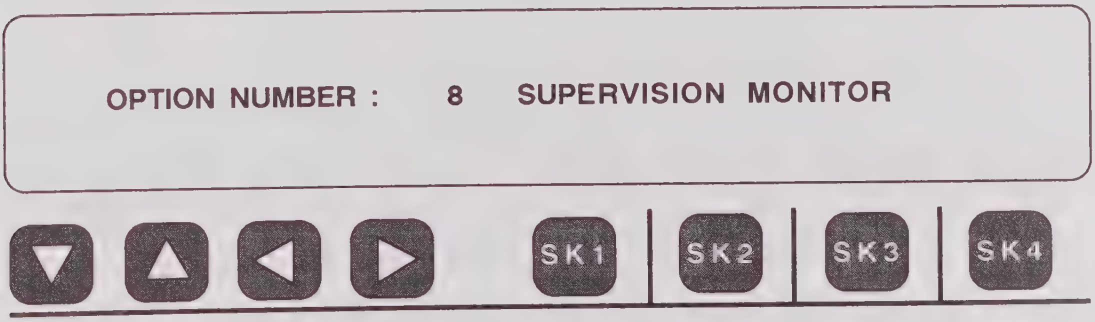
To use this Menu Option set it up in the following manner:

Press the OPTION MENU ■ ○ **Option Menu** function key.

Use the UP/DOWN ▼ ▲ arrow keys to

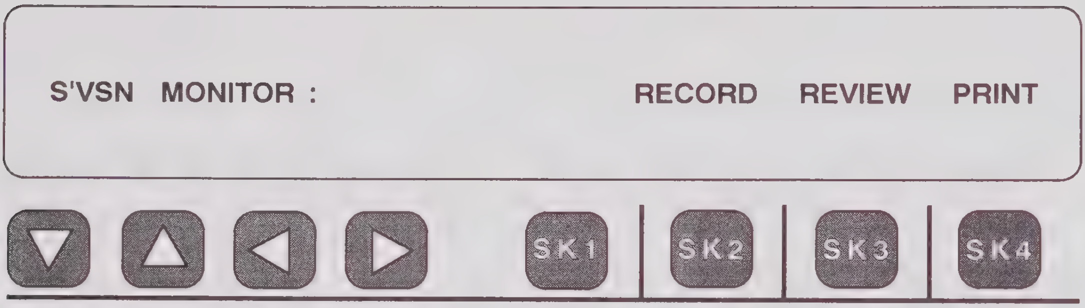
select Menu Option 08: SUPERVISION MONITOR.

The display will appear as shown below:

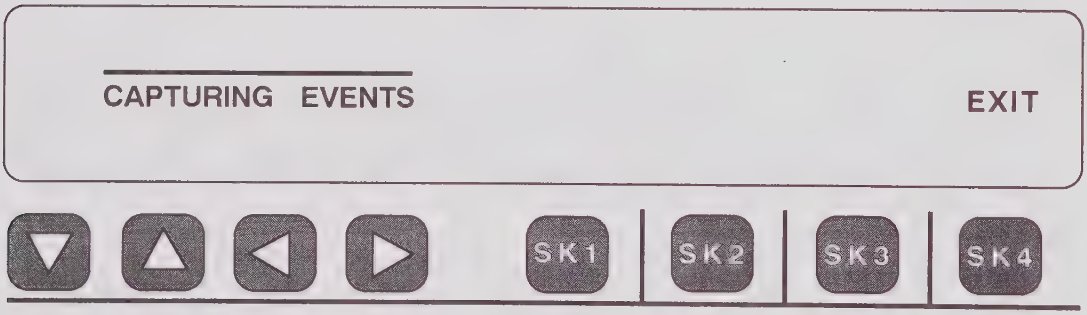


OPTION NUMBER : 8 SUPERVISION MONITOR

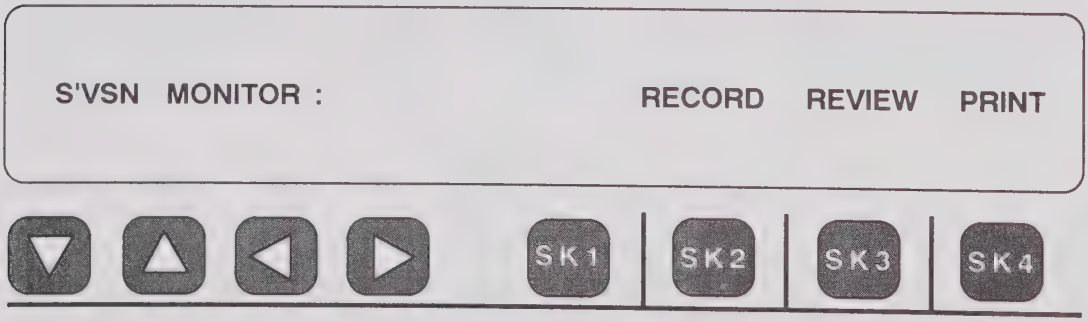
Press any softkey under the display to bring up the main menu:



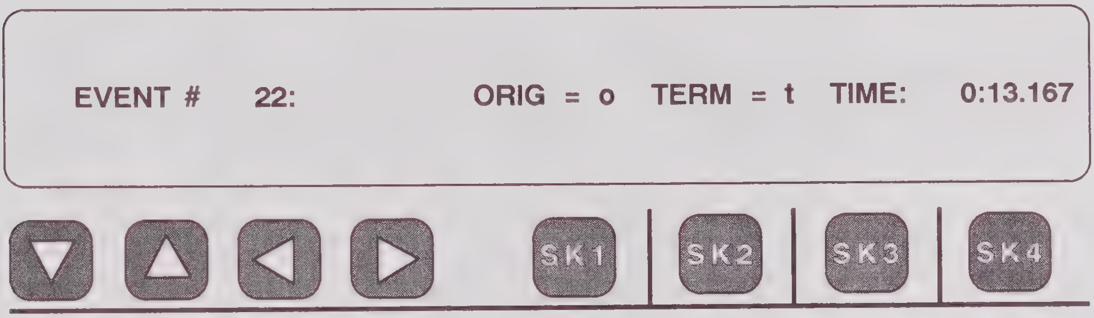
To record events in a time line format, press Softkey 2 (under **RECORD**) and the 930A will act very much like a strip chart recorder. It will record supervision events such as **On Hooks** and **Off Hooks**. Just as with a strip chart recorder however, it is up to you to determine what is going on over time. After pressing Softkey 2 the 930A display will appear as:



The cursor flashes over the words **CAPTURING EVENTS**. When you feel that enough data has been obtained, press Softkey 4 (under **EXIT**) to return the 930A to the main menu and stop the data acquisition. The main menu is repeated below:

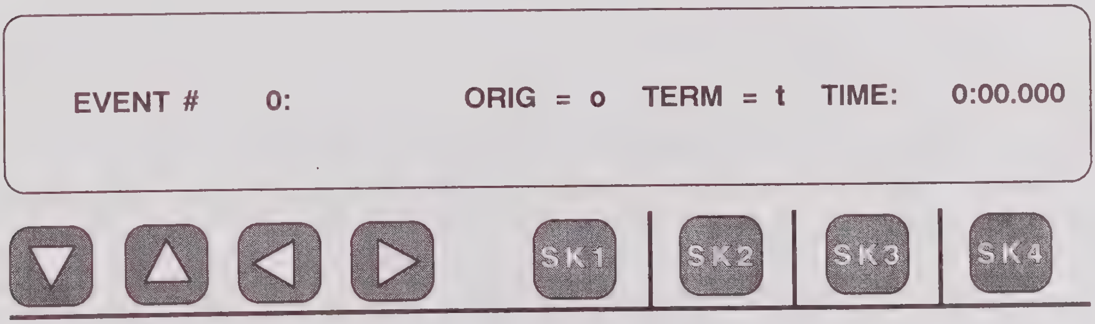


The events captured in the **RECORD** mode may now be reviewed by pressing Softkey 3 (under **REVIEW**). The display of the events varies according to the trunk type the 930A is set up to emulate. For example, if the 930A had been timing events on a metallic trunk such as a Loop Start or Ground Start trunk, the results would be displayed as shown in the example below:



```
EVENT #    22:              ORIG = o   TERM = t   TIME:    0:13.167
```

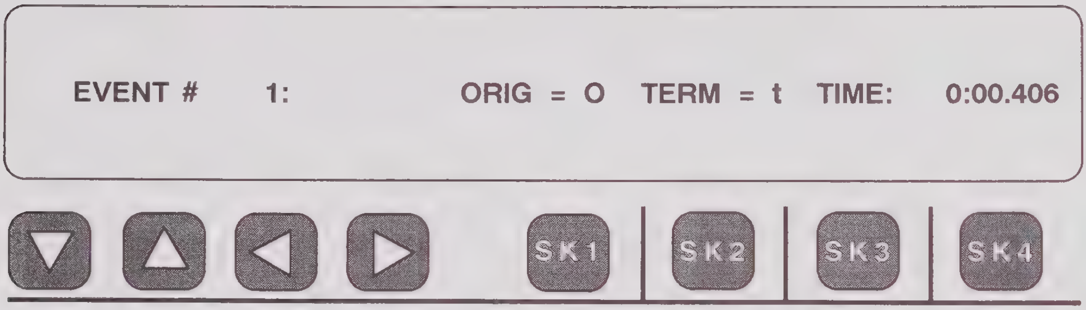
The display follows the front panel supervision LEDs. In this case both the Originate and Terminate sides of the circuit are **On Hook** as indicated by the lower case letters "o" and "t". The time is displayed as minutes: seconds.milliseconds up to 255:59.999. An example of a sequence of events will demonstrate how this works in practice. Suppose the 930A had been capturing events for a period of time. After stopping the data collection as described above, the first displayed result is:



```
EVENT #    0:               ORIG = o   TERM = t   TIME:    0:00.000
```

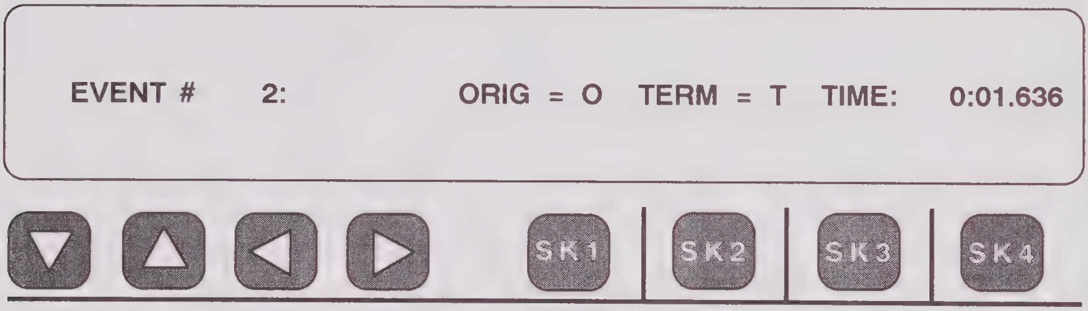
By pressing the **UP** Arrow key, or Softkey 1, you can scroll up through the rest of the results.

The next event, for example, might be:



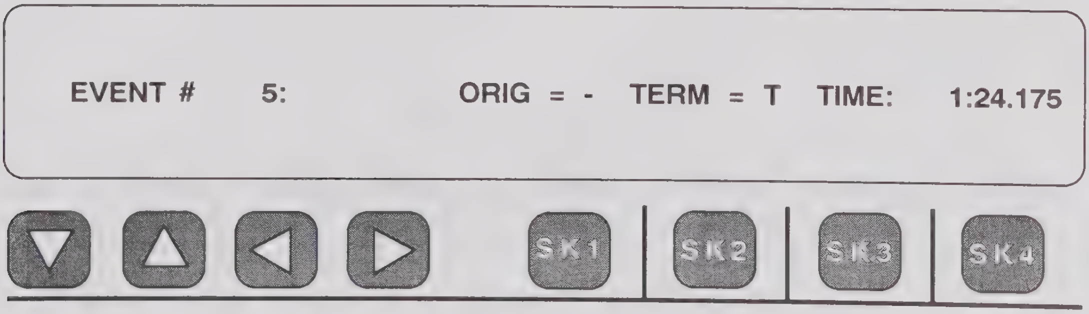
```
EVENT #     1:          ORIG = O   TERM = t   TIME:    0:00.406
```

Here the Originating end has gone **Off-Hook** (Uppercase O) after 406 milliseconds. The display of event #2 might be:



```
EVENT #     2:          ORIG = O   TERM = T   TIME:    0:01.636
```

The Terminate end has gone **Off-Hook** after 1.636 seconds. The 930A can **time up to 200 events or for up to 4 hours** unless a printer is connected. In this case the 930A continuously dumps its buffer when full and records continuously. If the supervision on the line enters an undefined state (neither **On Hook** nor **Off Hook**), the 930A will display it as undefined by showing a dash "-" instead of an upper or lower case character. Only supervision events are shown. Tones, digits and speech are not captured by the supervision monitor. **An undefined state** is shown below:



```
EVENT #     5:          ORIG = -   TERM = T   TIME:    1:24.175
```

3-10.6.1 MONITORING GROUND START SUPERVISION

Now that you have a rough idea of how Menu Option 8 functions, this example will explain how Ground Start supervision works and the kinds of events you might want to time using the 930A.

You set up the 930A to a Ground Start trunk type and then go to Menu Option 8, enter the menu, select **RECORD**, capture the events and then exit back to the main menu; just as it was detailed in the previous section. The hard part is figuring out what all this means.

Some of the supervision events you might want to time on a Ground Start trunk would include: The time it takes for the Central Office switch to recognize trunk seizure, the length of the Open Switch Interval (OSI), how long it takes your PBX to recognize Tip Ground, and how long the Central Office has to wait for loop from your PBX.

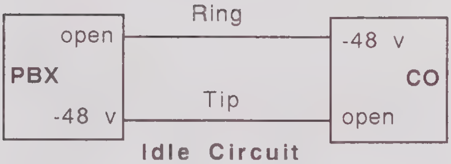
The example on the next page uses a sample of a printout of the supervision events and their timing which you would get if your 930A was connected to a printer (of course you would need Option 930A-10C). It also diagrams the various conditions of the circuit from the initial Off Hook request for service until the completion of the call. This should also facilitate your understanding of how a Ground Start circuit works.

GROUND START SUPERVISION

Diagram

Example of Supervision Printout

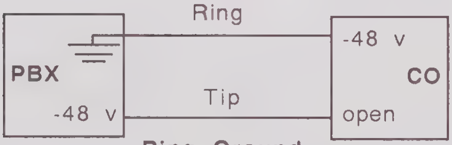
```
ORIG  TERM  TOTAL  EVENT
```



Idle Circuit

```
EVENT     #0:  o    t   0:00.000  2041
```

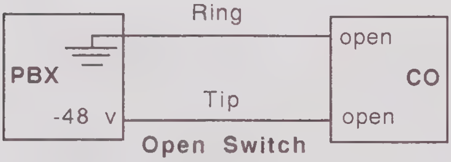
In the idle state, both Tip and Ring are at -48v. The length of time a circuit is idle between calls is shown as the EVENT time for this state.



Ring Ground

```
EVENT    #1:   O    t   0:02.041     349
```

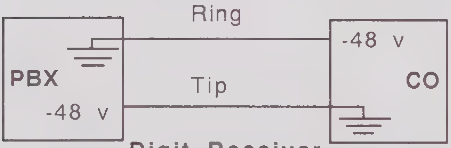
In the Ring Ground state, the PBX seizes the circuit. Tip remains at -48v. while Ring goes to ground. The EVENT time is the time it takes for the C.O. to recognize the seizure.



Open Switch Interval

```
EVENT    #2:   -    t   0:02.400     100
```

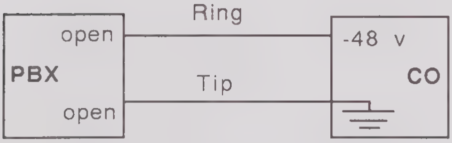
The Open switch interval occurs when the C.O. prepares to connect a digit receiver. There is no supervision battery on Ring. The EVENT time is the length of the open switch interval (OSI).



Digit Receiver Connected

```
EVENT     #3:  O    T   0:02.500   50
```

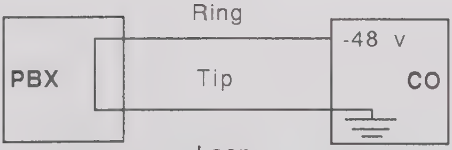
The C.O. switches to a loop circuit, providing ground on Tip, and attaches a digit receiver. Tip and Ring are both grounded. The EVENT time is how long it takes for the PBX to recognize Tip ground.



PBX Switching To Loop

```
EVENT     #4:  o    T   0:02.550   30
```

A brief Open switch interval at the PBX occurs when it removes Ring ground and supervision battery, before looping Tip to Ring. Ring goes to -48v. while Tip remains grounded. Add this EVENT time to the preceeding EVENT time to see how long the C.O. must wait for loop from the PBX (80 msecs.).



Loop

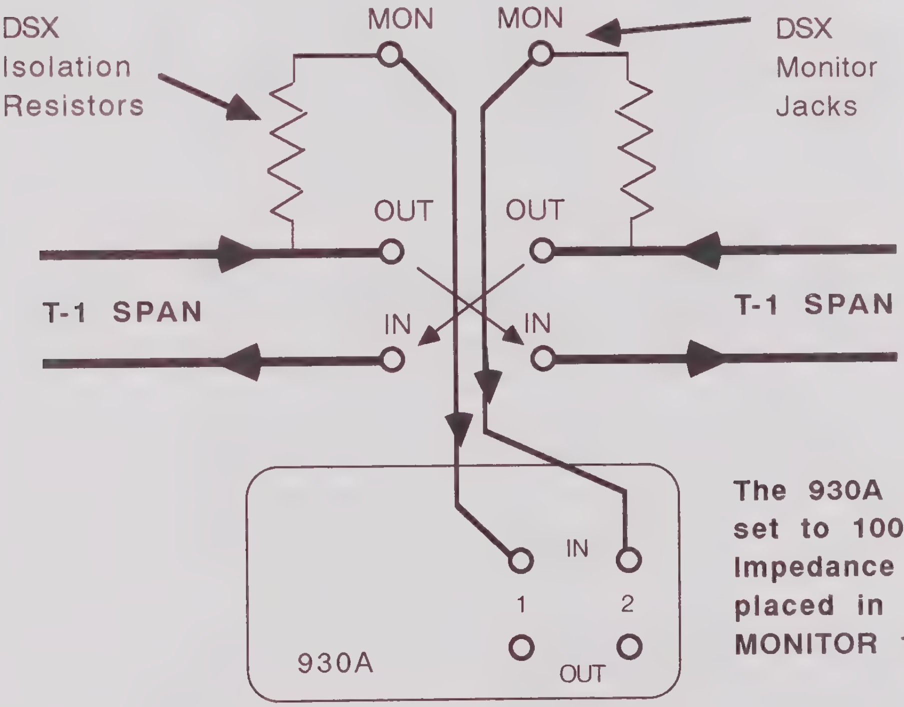
```
EVENT     #5:  O    T   0:02.580   60420
```

The circuit is now an ordinary loop trunk. The EVENT time includes dialing, call completion and the call itself.

3-10.6.2 MEASURING ABC&D BIT SUPERVISION ON PCM CHANNELS

If you have purchased a 930A equipped with Option 930A-08E or 930A-09E, then events on T-1 PCM trunks can also be timed. The procedure is much the same as with metallic analog trunks.

This is best accomplished with Option 930A-09E by connecting the two PCM receivers of the 930A to the monitor jacks of the DSX for both directions of transmission. You need not be in the Terminate or Drop & Insert modes to make these measurements. The set-up of the 930A Trunk Type function is detailed in Section VI of this manual. The diagram below provides you with the basic test cord connections and 930A trunk settings.



The 930A should be set to 100 ohms Impedance and placed in the MONITOR 1&2 mode.

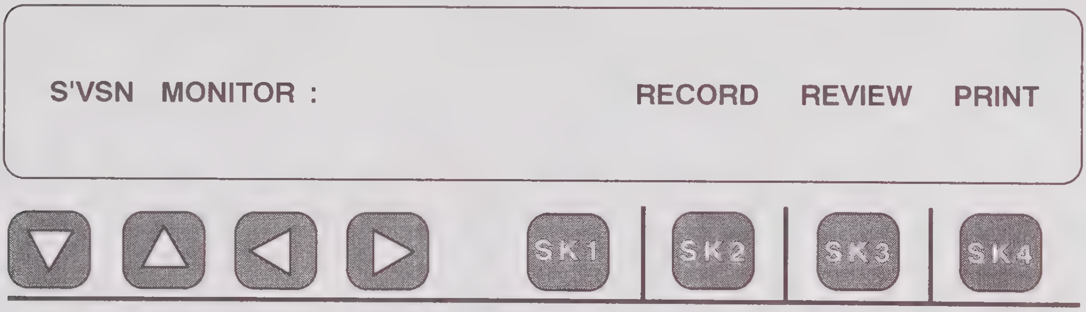
PCM MODE: MONITOR 1&2

Once you have set the 930A to PCM Trunk Type, selected PCM, set the mode to **MONITOR 1&2**, and set in the 100 ohm impedance, you can connect the 930A to the T-1 span you want to test. After selecting the desired PCM channel you can proceed to the **OPTION MENU** key and select Menu Option 8: **SUPERVISION MONITOR**.

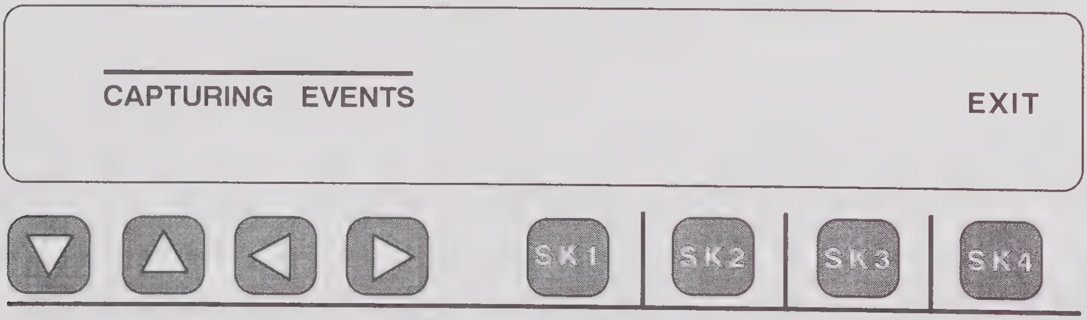
If the T-1 span you are on is a normal D4 Superframe type, all you have are A and B bits for supervision. If you happen to be on a new Extended Superframe T-1 span, you will have A, B, C and D bits. At the present time, the operating companies tie the A and C bits, and the B and D bits, together. So there will be no difference measuring between AB or CD bits for a while. No one knows quite what to do with the extra bits yet.

For example purposes we will assume that we are measuring events on a normal D4 Superframe span which is the most common format. **PCM IN 1** is connected to the outgoing side of the span from the near office. **PCM IN 2** is connected to the incoming side from the distant office.

To begin capturing event times, press Softkey 2 (under **RECORD**) below:



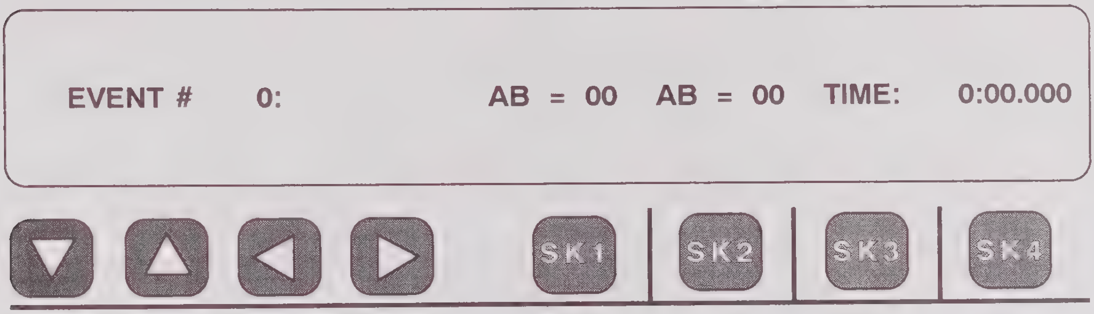
Once you press the **RECORD** softkey, the 930A considers that to be time 0 and begins recording changes in the A and B bit states. The 930A will indicate that it is capturing events by presenting the following display:



You can stop recording whenever you want by pressing Softkey 4 (under **EXIT**). The 930A will stop recording after it reaches 200 events or after 4 hours, whichever comes first **unless** you have connected the 930A to a

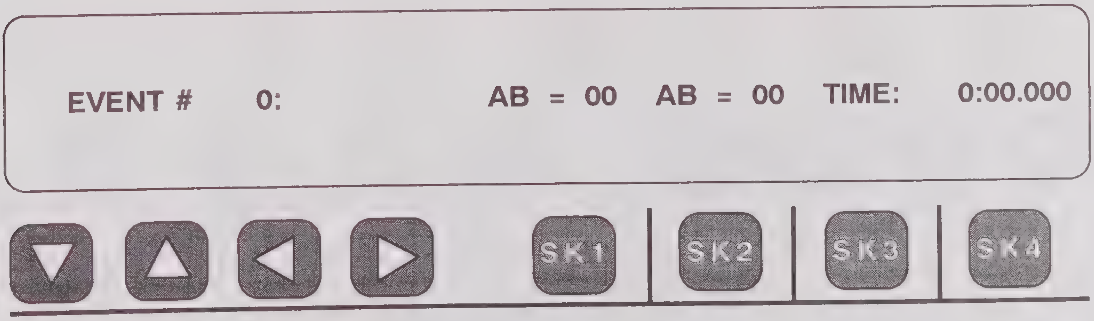
Printer and set Menu Option 3 to **PRINTER** remote. In this case the 930A will continuously dump its buffer whenever it is full, reset, and record more events.

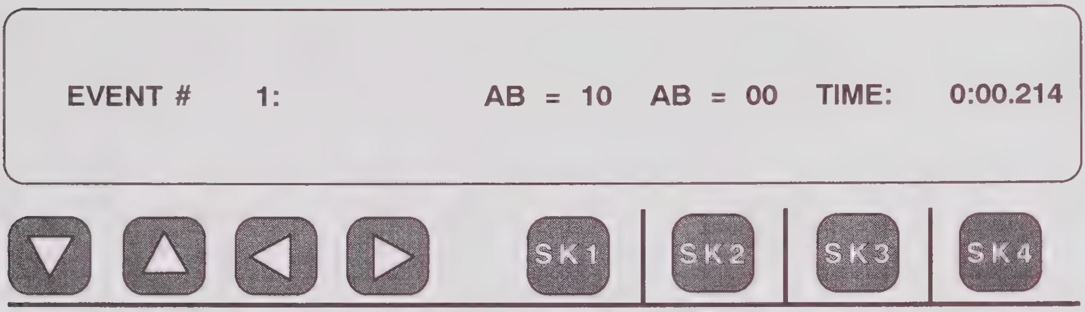
After some events have been recorded, press Softkey 4 and exit back to the main menu. Press Softkey 3 to **REVIEW** the results. When you press the **REVIEW** softkey the first display will come up as shown below.



In this example, the originating, or near end A and B bits are on the left and the terminating, or far end bits are on the right. Both sides are showing **ON HOOK** since the A and B bits are 0 on both sides. The time is displayed to the right as it was for the previous analog trunk example. The A and B bit states may actually vary for **On** and **Off-Hook** indications, depending upon whether a normal trunk or a foreign exchange trunk is accessed on a real span. **If you are on an Extended Superframe span, you can press Softkey 1 or 2 to view the C and D bits as well as the A and B bits.**

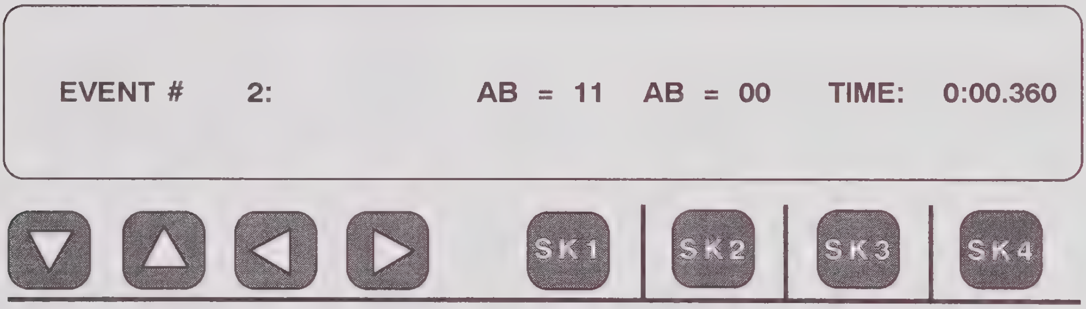
Some typical measurement displays follow. You press the **UP** or **DOWN** Arrow keys, or Softkey 3 (under **TIME**), to move from event to event.





EVENT # 1: AB = 10 AB = 00 TIME: 0:00.214

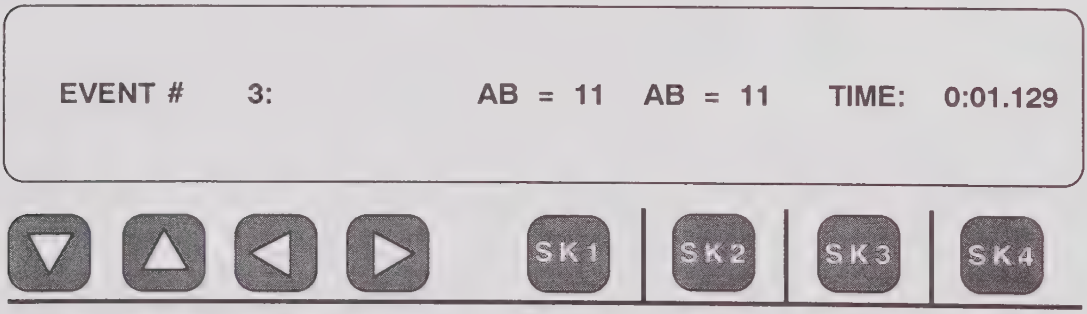
This indicates that the originating A bit went high after 214 milliseconds. Pressing the **UP** Arrow key, or Softkey 3, would bring up event #2.



EVENT # 2: AB = 11 AB = 00 TIME: 0:00.360

Here, the originating B bit went high 146 milliseconds after event #1 or 360 milliseconds into the measurement.

Pressing the **UP** Arrow key again brings up:



EVENT # 3: AB = 11 AB = 11 TIME: 0:01.129

This shows that the next event was the terminating ends A and B bits going high or **OFF HOOK** after 1.129 seconds had elapsed.

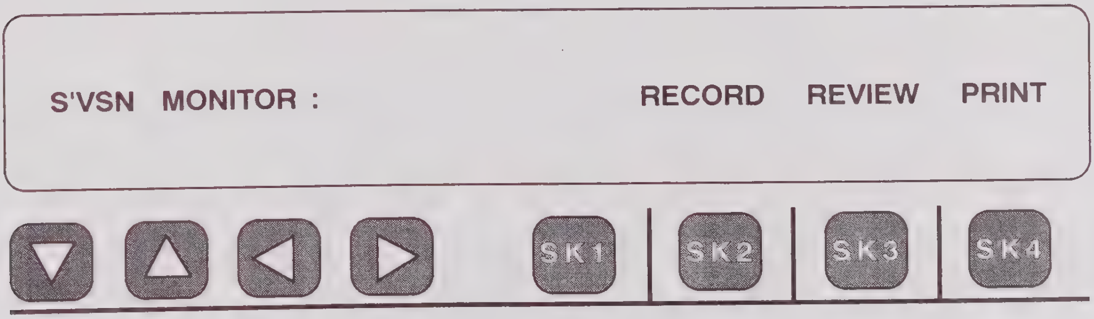
These are just examples of displays and are not meant to convey any sense of real events. They merely illustrate the operation of the Supervision Monitor function on analog and PCM trunks.

With this feature, you can measure guard intervals, times between the last digit dialed and an Off Hook indication, and the time between a request for service and the response back, to name a few. It can also be used on services such as Enhanced 911 to measure the call completion time. In the case of E911, this must be less than 3 seconds.

3-10.6.3 HOW TO PRINT MEASUREMENT RESULTS

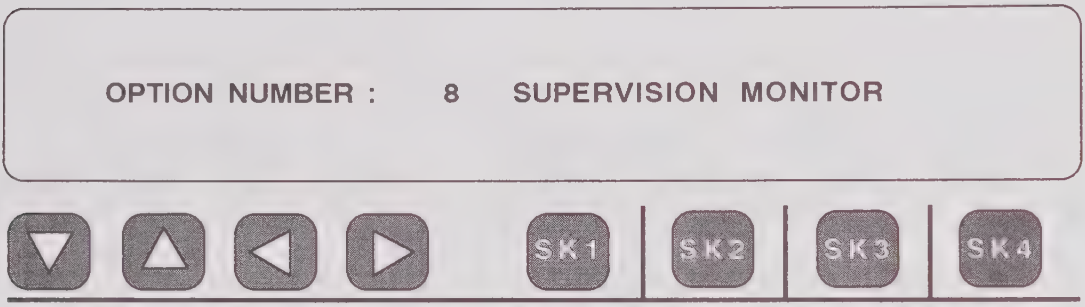
Finally, this function provides the ability to print out the results on a demand basis, as opposed to using the **PRINT** function contained under Option 930A-10C. If the **PRINT** function under Option 930A-10C is enabled, everything will be printed out when the 930A's buffer is full. The Supervision Monitor function has a **PRINT** key (Softkey 4 in the main menu) so that results of measurements can be printed out on demand. This still requires the 930A to have Option 930A-10C installed. This provides the RS-232 interface to a serial printer.

To obtain a printout on demand from the 930A, return to the main menu shown below by pressing the **OPTION MENU** key:



Press Softkey 4 (under **PRINT**) and the 930A will print out the event timing results it has accumulated to that point. It will also perform some math for you by printing out the time difference between events as described in the Ground Start example.

To exit from the Supervision Monitor and return to the main Menu Option list, press the **OPTION MENU** key, or any other function key.



OPTION NUMBER : 8 SUPERVISION MONITOR

At this point you can go to any other menu or function.

3-10.7 HOW TO MEASURE WINK TIMING (MENU OPTION 9)

Menu Option 9: **WINK TIMING** is used with, and is automatically set up by, Menu Option 2: **SEND DIGIT SEQUENCES** or Menu Option 4: **DIGIT RECEIVER** (if Option 930A-01 has been purchased). Menu Option 9 enables timing of Wink, Pre-Wink (Guard Time), and Off Hook Supervision events.

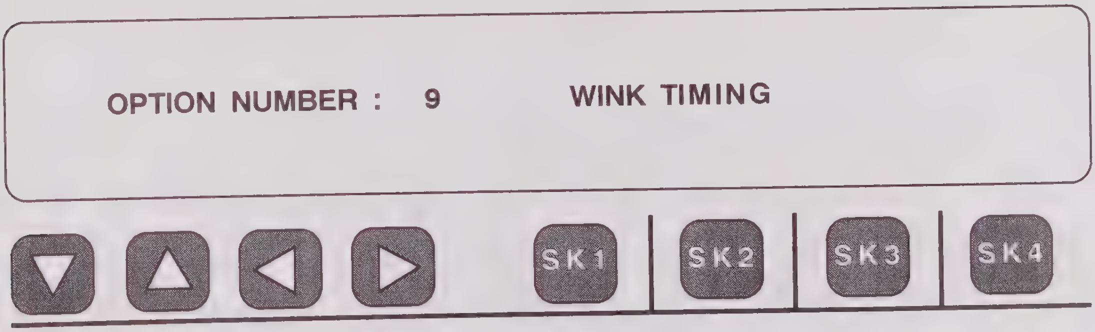
To use Menu Option 9, you **must first** set up a digit sequence in Menu Option 2 (such as the Feature Group D example in Section 3-10.3.1), or set up the sequence to be received in Menu Option 4 (Refer to Section 4-2).

After you have outpulsed the call, **then** you can measure the **Wink Timing** by going to Menu Option 9 as follows:

Press the OPTION MENU function key.

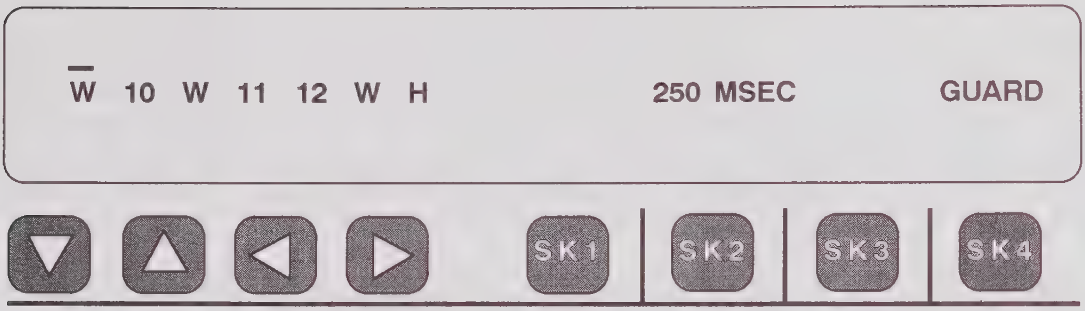
Use the UP/DOWN arrow keys to select Menu Option 9: WINK TIMING.

The 930A display will show:



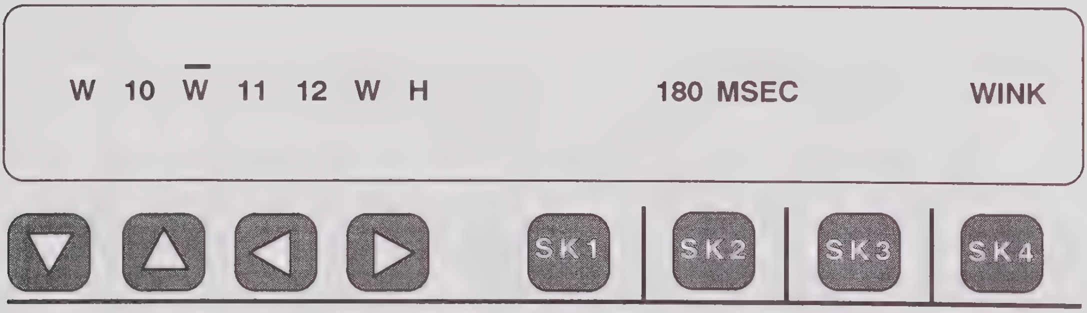
OPTION NUMBER : 9 WINK TIMING

Enter the Menu Option by pressing any softkey. The display will show you the sequence as it was keyed in under **SEND DIGIT SEQUENCES**. For example, if the Feature Group D sequence from Section 3-10.3.1 is used, the display will appear as shown on the following page.



A flashing cursor will appear over the last completed wink or Off-Hook in the sequence. If a wink or Off-Hook has failed, the cursor will appear over the failed event. If the sequence has not yet been outpulsed, the cursor will appear over the first supervision event and all measurements will be zero. There will be a measurement, "NNNN MSEC", where NNNN is the length of time in milliseconds spent waiting for the event (the Guard Time). The word "**GUARD**" is displayed to label the measurement. This is the time from initial seizure to the beginning of the Wink.

The left and right arrow keys allow you to move the cursor within the sequence to examine any supervision event. For example, you may want to measure the duration of the second wink in the sequence above. Using the Right arrow key, move the cursor over the second wink, then press Softkey 4 and a display will appear similar to the one below:



The measurement always refers to the event under the cursor. Softkeys 1, 2, and 3 are inactive while Softkey 4 toggles between **GUARD** and **WINK** timing measurement (if the event is a Wink), or **GUARD** and **OFF HOOK** time measurement (if the event is an Off-Hook).

All measurements are in milliseconds. If the Guard time exceeds 16 seconds, the event "fails". In such a case the **GUARD** display would read

">16000 MSEC", and the wink or off-hook measurement would read **"FAILED"**.

If the event is a wink, it fails if the period exceeds 600 msecs. If the event is an off-hook, it fails if this period is less than 200 msecs. You can also use Wink Timing to measure Delay Dial events. A Delay Dial event fails if the Guard period exceeds 16 seconds, or if the off-hook period exceeds 16 seconds.

3-10.8 USING THE FREQUENCY SWEEP (MENU OPTION 10)

Menu Option 10, **FREQUENCY SWEEP**, is a standard feature on all Model 930A's. This Menu Option lets you set the 930A to sweep up or sweep down in frequency, either one time or continuously. The frequency limits, step size, amplitude, and sweep times are user-selectable for maximum flexibility. In addition, you can set the 930A to either skip ,or not skip, the SF frequency during the sweep.

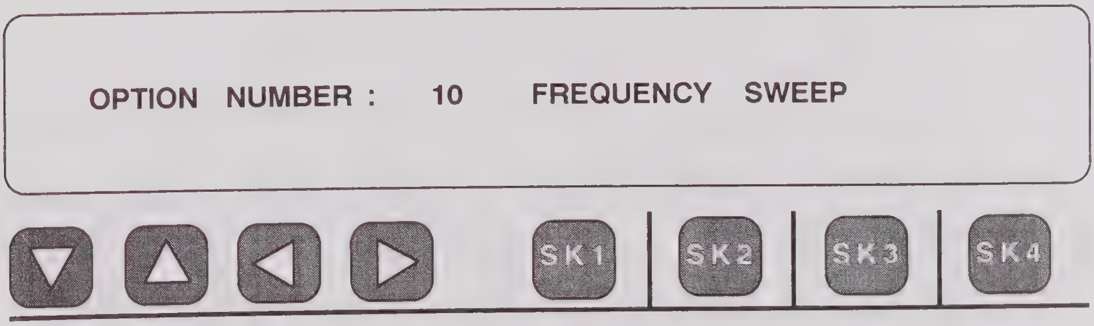
Prior to attempting to set-up the frequency sweep, you should set the 930A to the appropriate Trunk Type using the procedures in Section 3-4 or Section 4-3 and 6-1 for optional Trunk Types. To set up the 930A frequency sweep function, perform the following steps:

Press the OPTION MENU

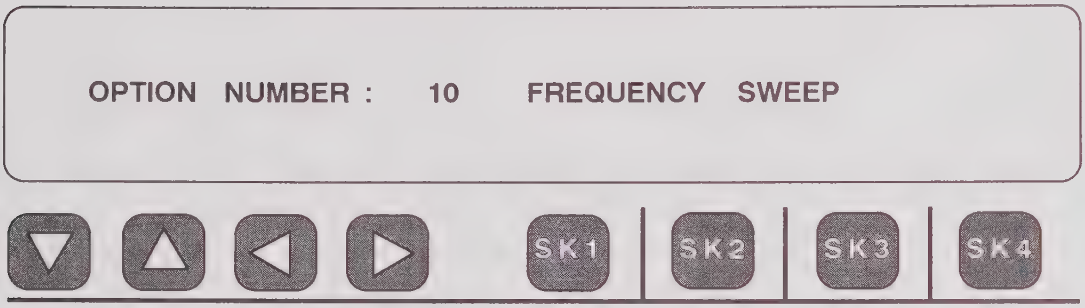
function key.

Use the UP/DOWN arrow keys to select Menu Option 10: FREQUENCY SWEEP.

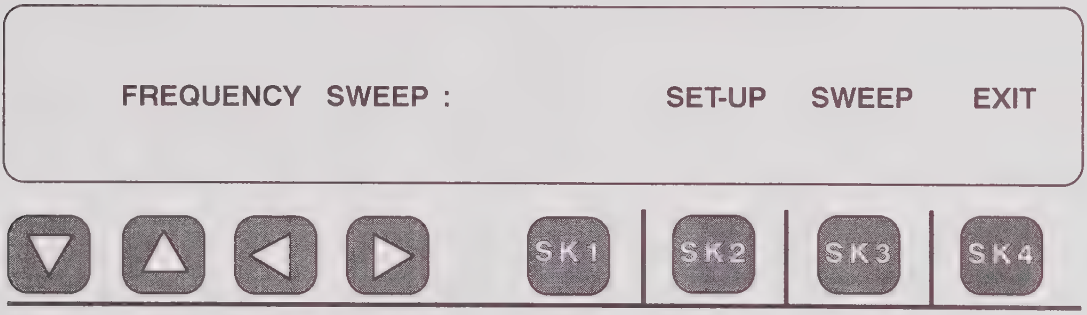
The 930A display will appear as shown below:



OPTION NUMBER : 10 FREQUENCY SWEEP



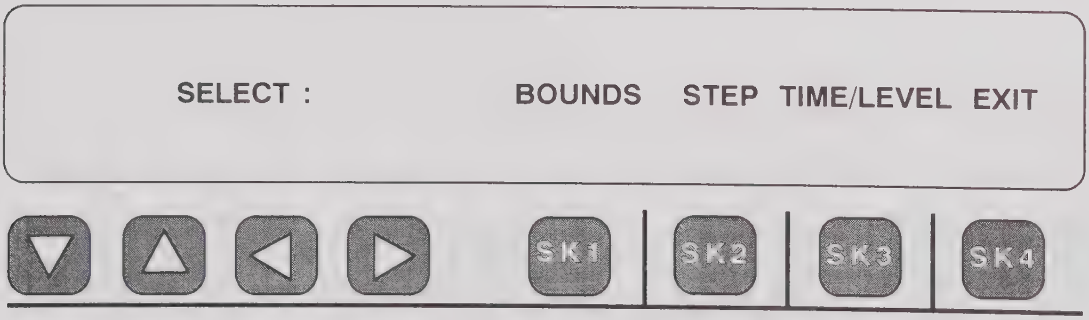
Pressing any softkey will get you into the Menu Option. Once inside Menu Option 10 the 930A display will be as shown below:



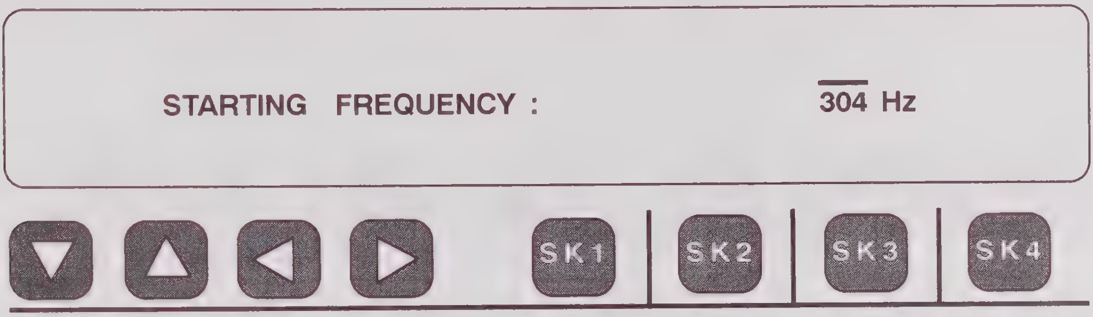
The 930A retains any set-ups previously input. It is not normally necessary to go through the set-up process each time the sweep function is used, unless you want to change the parameters.

The 930A's standard default sweep setting is the most commonly used sweep for attenuation distortion measurements. Most of the time you can go directly to **SWEEP**. **The default parameters are:** Sweep from 304 Hz to 3204 Hz in 100 Hz steps, skip the SF frequency band, wait 3.5 seconds between frequencies and send at a level of -16 dBm. An example of how to change these values follows.

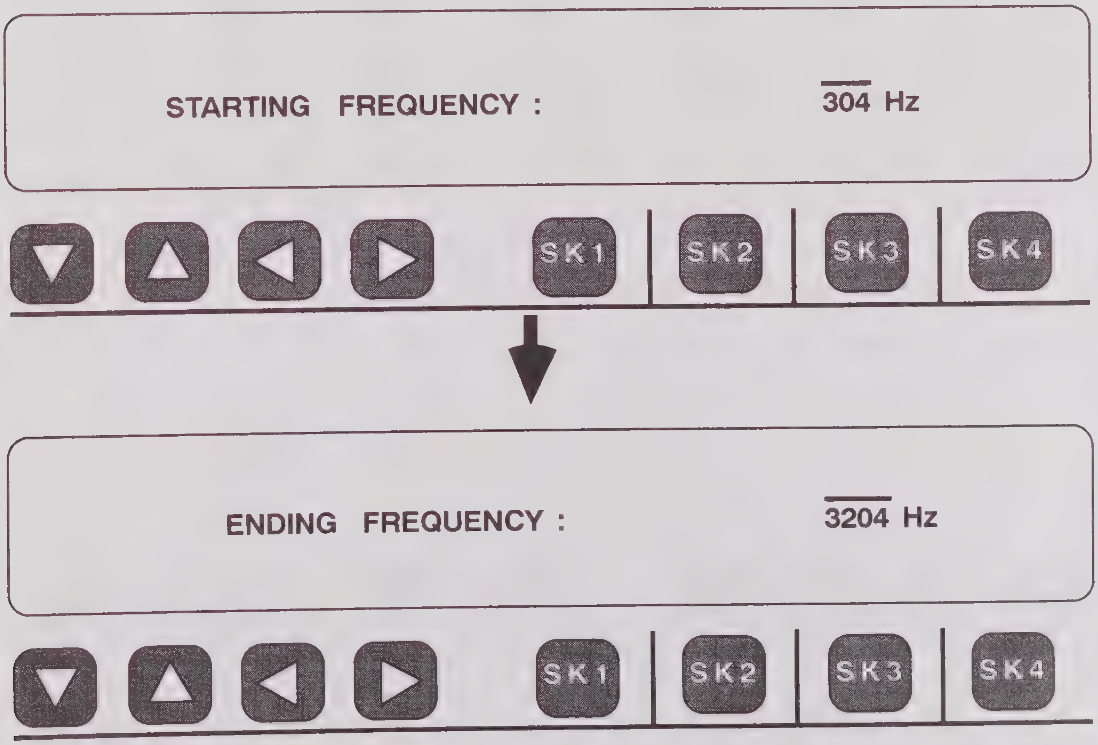
Press Softkey 2 (under **SET-UP**) and the 930A display will appear as:



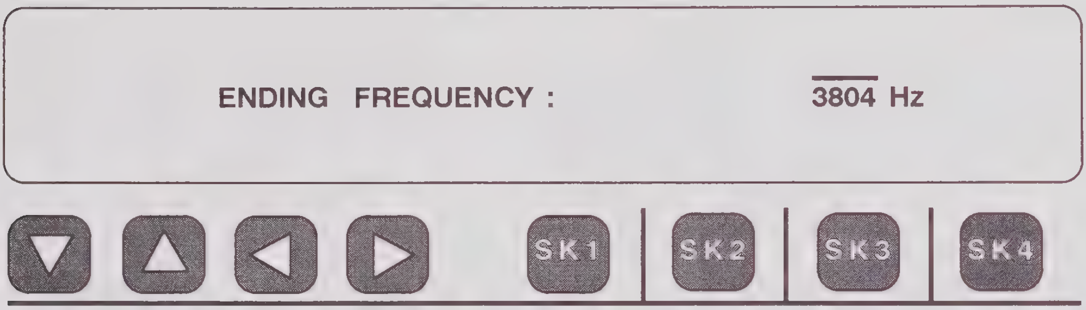
The following procedure outlines the steps to set-up the 930A sweep function for a frequency sweep of 204 Hz to 3804 Hz in 200 Hz steps with 5 seconds between frequencies and SF skip instead of the default. Press Softkey 1 (under **BOUNDS**) and the 930A display will show the last starting frequency used.



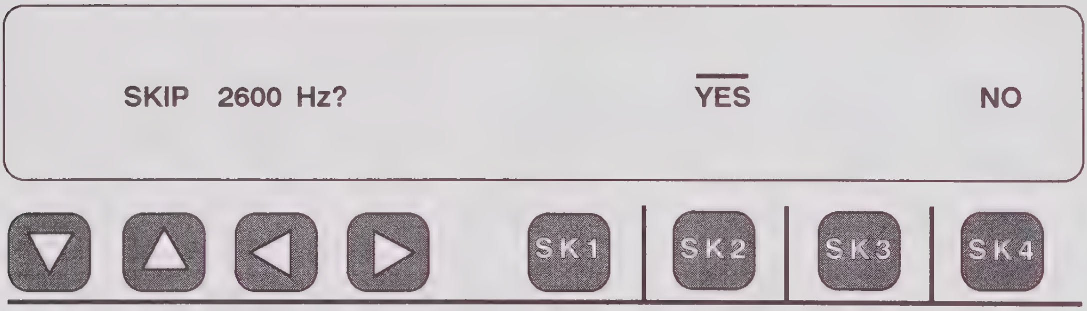
Here 304 Hz was the previous starting frequency. We want the 930A to sweep up from 204 Hz to 3804 Hz. To do this, enter the sequence **"0", "2", "0", "4"** on the keypad and press the **ENTER** key, or Softkey 3, to enter the 204 Hz value. The 930A enters the value and then asks you to enter the ending frequency you want,



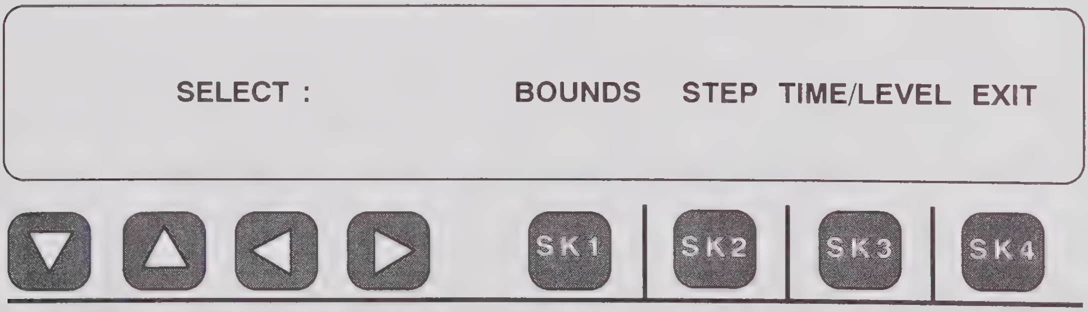
We want the ending frequency to be 3804 Hz so we enter the sequence "**3**", "**8**", "**0**", "**4**" on the keypad and press the **ENTER** key, or Softkey 3, to enter the 3804 Hz value. The display momentarily shows the new value as:



After entering the new ending frequency, the display changes to:

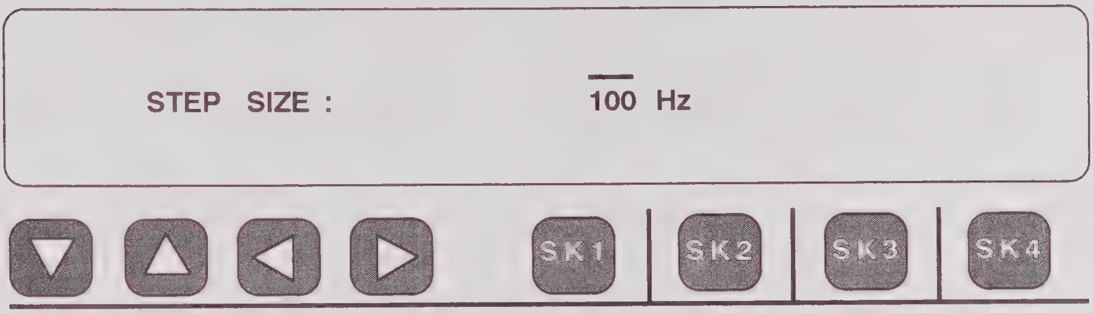


The 930A is now asking whether you want to skip the SF frequency (actually skips 2450 Hz to 2750 Hz) or not. Since we wanted to skip SF for this example anyway (usually you do skip SF), press Softkey 2 (under **YES**) and revert to the selection menu display shown below:

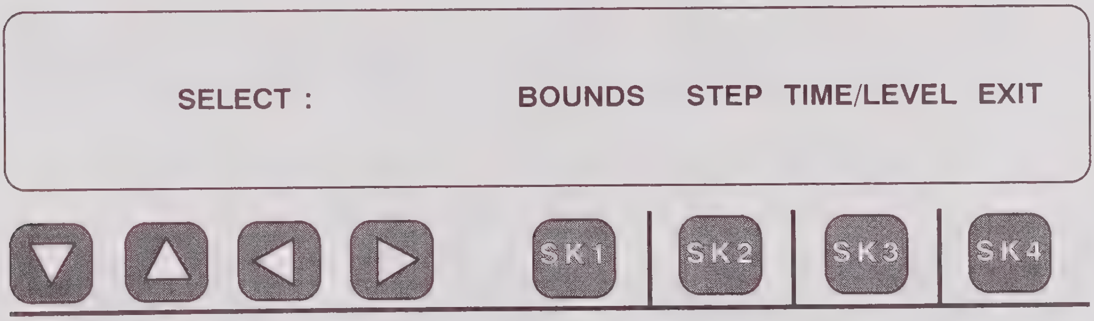


Now that the frequency bounds have been set, the next item is setting the frequency step size of the sweep. The 930A allows step sizes from 1 Hz to

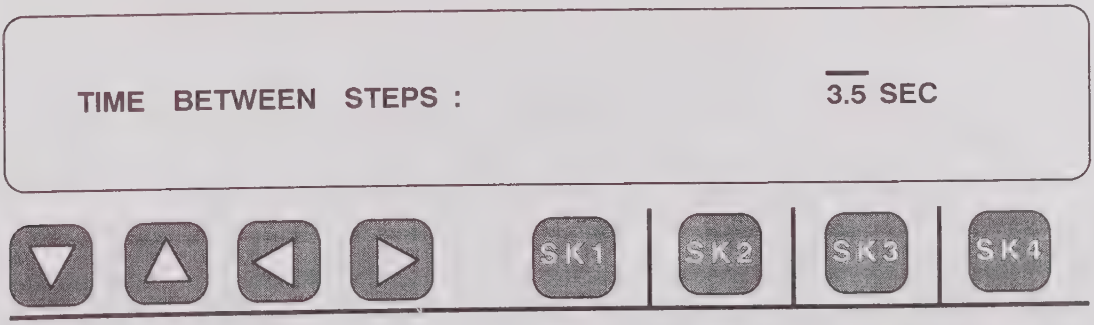
999 Hz but the most common step size is 100 Hz. To change from this default value to the 200 Hz steps called for in this example press Softkey 2 (under **STEP**) and the 930A display becomes:


STEP SIZE : $\overline{100}$ Hz

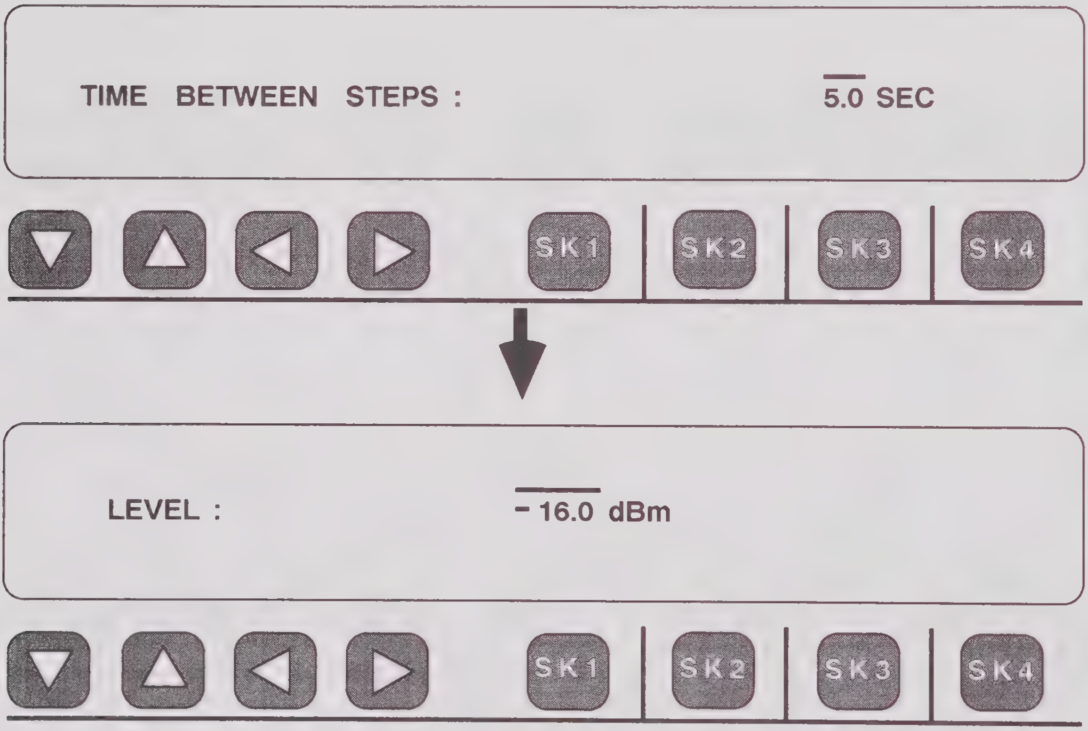
Enter the sequence **"2"**, **"0"**, **"0"** and press the **ENTER** key or Softkey 1. The 930A will momentarily show the new step size and then return to the selection menu below:


SELECT : BOUNDS STEP TIME/LEVEL EXIT

The next step is to select the sweep time between steps and the level at which the tones are to be sent. Press Softkey 3 (under **TIME/LEVEL**) and the 930A display becomes:


TIME BETWEEN STEPS : $\overline{3.5}$ SEC

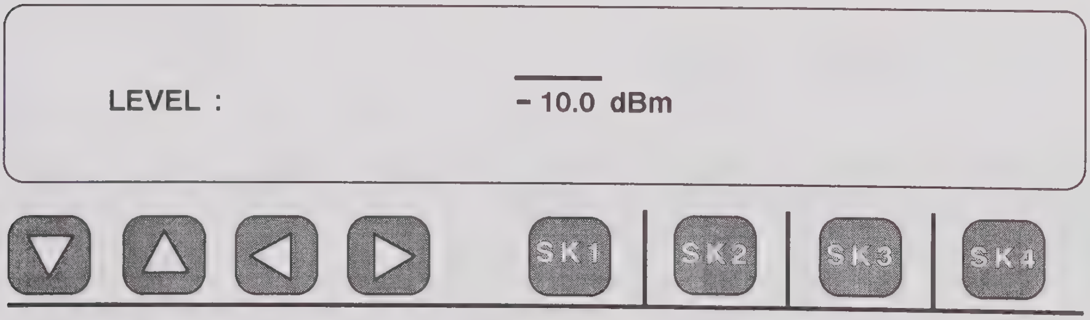
The 930A lets you select sweep times from 0.1 seconds to 9.9 seconds. The default is 3.5 seconds. A reasonable value which allows for instrument settling time as well as operator convenience is about 5 seconds. To enter a value of 5 seconds, use the numeric keypad to enter the sequence "**5**" and "**0**" and press the **ENTER** key, or Softkey 3. The 930A will immediately enter the value and change to the level select display below:



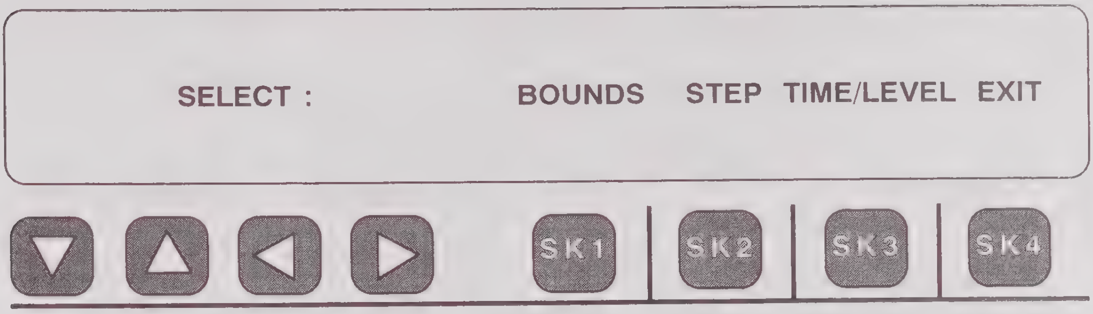
TIME BETWEEN STEPS : 5.0 SEC

LEVEL : – 16.0 dBm

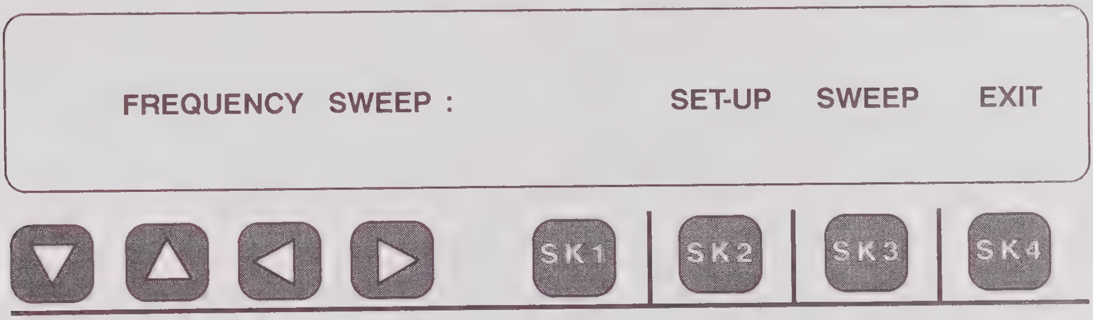
To change the level to -10.0 dBm from the -16.0 dBm default, enter the sequence "**1**", "**0**", and "**0**" and press the **ENTER** key, or Softkey 1. The 930A will momentarily show the new level and then reverts to the main menu:



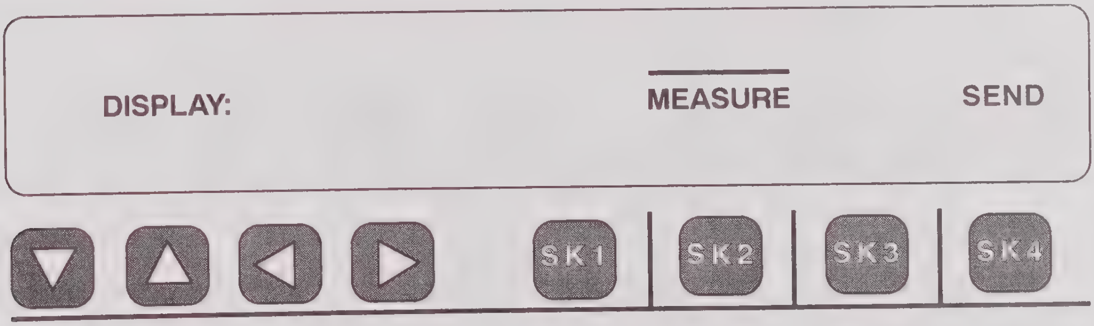
LEVEL : – 10.0 dBm



After you have entered the new sweep parameters, press Softkey 4 (under **EXIT**) to return to the main sweep menu shown below.

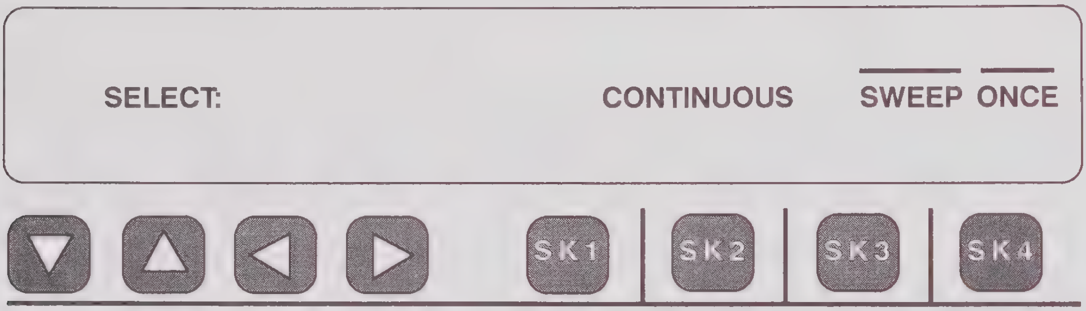


Pressing Softkey 3 (under **SWEEP**) causes the 930A to display:

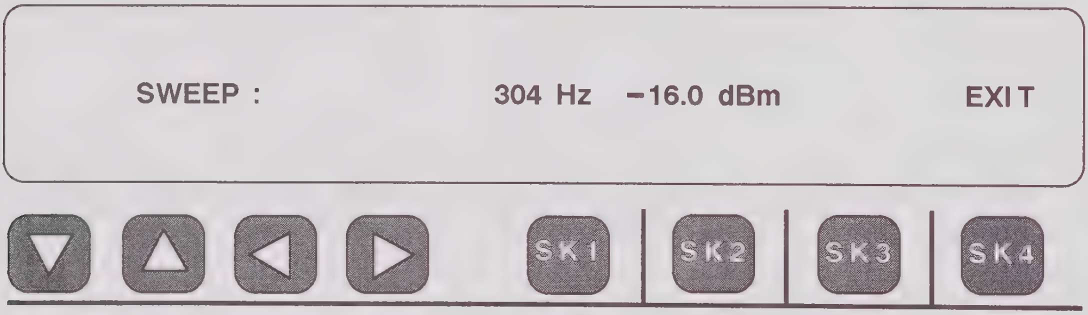


The flashing cursor appears over the previous selection. The two choices are **MEASURE** and **SEND**. The **MEASURE**, or 4-wire mode, enables the 930A to send and receive the sweep frequencies simultaneously. The **SEND**, or 2-wire mode, sends the sweep frequencies out from the 930A but does not receive. This mode would be used only for end-to-end measurements on 2-wire trunks where another test set is receiving the sweep at the far-end.

To select the **MEASURE** mode, press Softkey 2 and the 930A display will immediately change to the following:

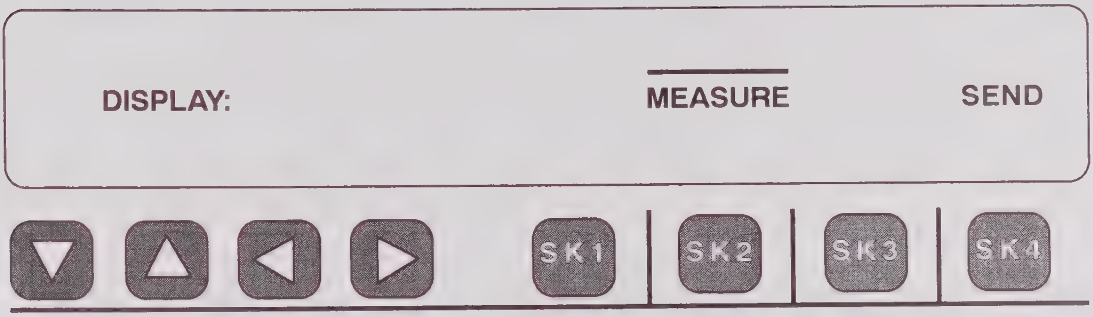


This asks you to choose between a one time sweep or a repetition of the sweep. Pressing Softkey 2 chooses continuous sweep and Softkey 4 chooses single sweep. If either key is pressed, the 930A immediately begins to send tone from the start frequency provided that the front panel Hook Switch has been placed in the **OFF HOOK** position. If the far-end has been looped back or another set is sending, then the 930A display will show the received frequency and level. An example of such a display is shown below:

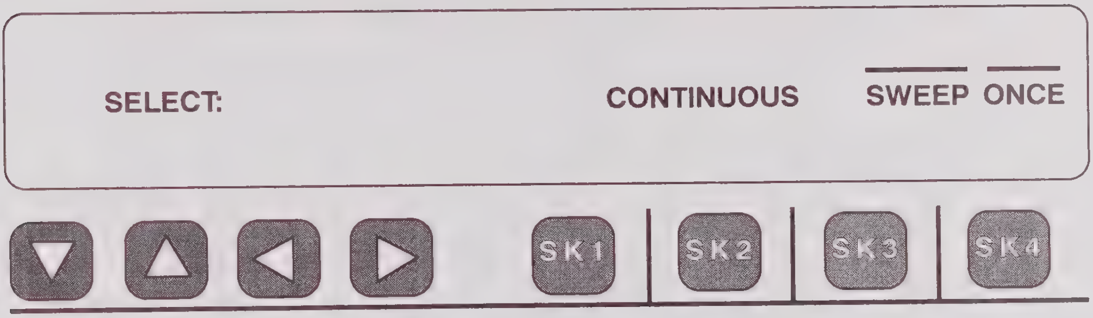


In the **MEASURE** mode, this is the received level and frequency. The 930A might be sending at -10.0 dBm and receiving at -16.0 dBm which would indicate a two-way loss of 6 dB at 304 Hz in this case. On a 2-wire trunk you must choose the **SEND** mode of operation because you cannot send and receive at the same time on a 2-wire trunk. The 930A display shows the outgoing tone level and frequency in this case.

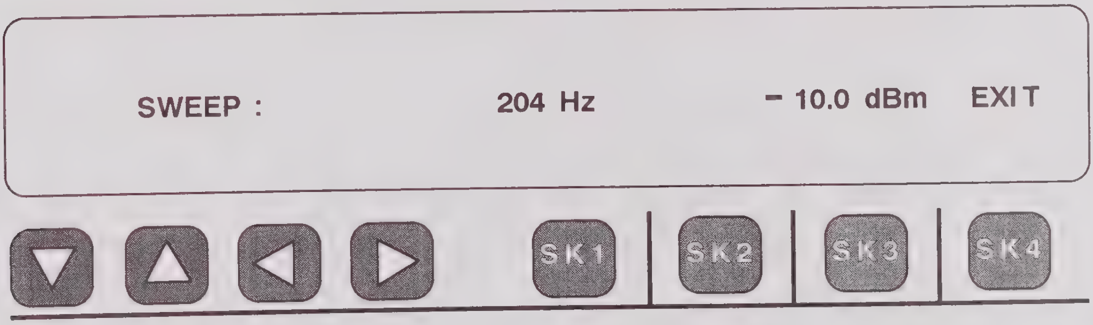
To choose the **SEND** mode of operation, press Softkey 4 (under **SEND**):



After pressing Softkey 4, the 930A display becomes:

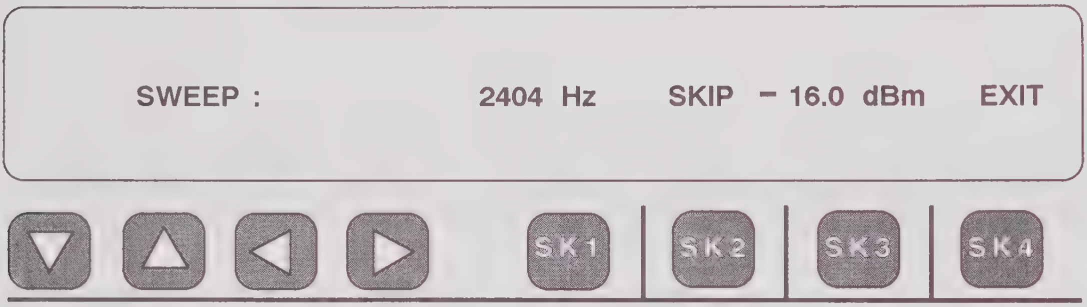


Press Softkey 2 (under **CONTINUOUS**) to continuously sweep through the band of frequencies selected, or press Softkey 4 (under **SWEEP ONCE**) to sweep once and stop. A typical 930A display might appear as:



The 930A would step the frequencies by 200 Hz, starting at 204 Hz and proceeding to 404 Hz, 604 Hz, and so on.

Since SF skip was also chosen, the 930A would hold at 2404 Hz and pick up the sweep again at 2804 Hz. The 930A display alerts you to the fact that SF is being skipped by showing the word **SKIP**:



SWEEP : 2404 Hz SKIP − 16.0 dBm EXIT

Some final points about the Frequency Sweep Menu Option follow. You can sweep down in frequency (in this example the sweep was up in frequency) by simply making the starting frequency the higher frequency and letting the ending frequency be lower. The 930A will then figure out that you want to sweep down, instead of up. The rest of the procedure is the same as that described in the example above. If a single sweep is chosen, the 930A will revert to the main sweep menu when the sweep has been completed.* You can stop the sweep at any time by pressing Softkey 4 (under **EXIT**), or the **OPTION MENU** key itself.

* If a continuous sweep is selected, the sweep will repeat until the operator manually stops it by pressing the **OPTION MENU** function key.

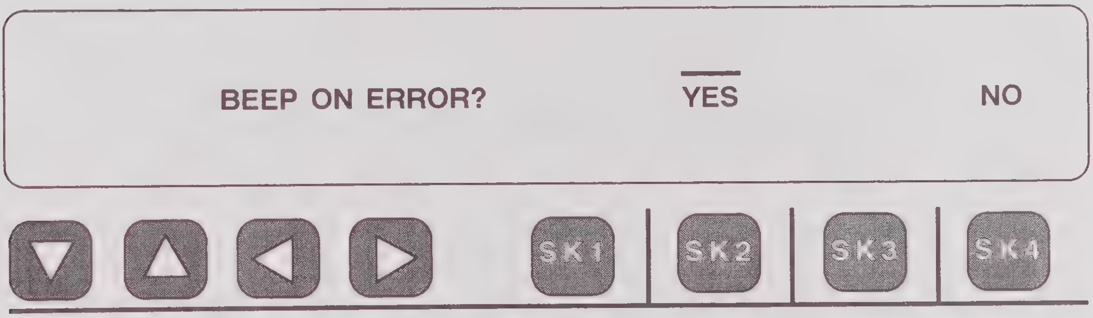
3-10.9 HOW TO STOP THE 930A FROM BEEPING (MENU OPTION 15)

Menu Option 15: **BEEP ON ERROR** provides you with an audible indication of various types of errors. These include errors of commission such as, trying to select a Trunk Type option that has not been installed. Since there are times when you don't care to listen to the beep, this Menu Option provides the means to turn off the beep without cutting the wires to the speaker. To control the **BEEP**, do the following:

Press the OPTION MENU ○ **Option Menu** function key.

Use the UP/DOWN ▽ △ arrow keys to

to select Menu Option 15: BEEP ON ERROR.



BEEP ON ERROR? **YES** **NO**

If the cursor appears over the **YES** field, the **BEEP** has been turned **on**. To turn it **off**, press Softkey 4. You are now free to make all the operating mistakes you want without the annoying **BEEP** to disturb you. To turn the **BEEP** back on, return to Menu Option 15 and, once inside the menu, press Softkey 2. If you have ordered Option 930A-10C (Remote Control), disabling the beep also prevents the 930A from sending the "Bell" character (ASCII 07) to a remote printer, terminal, or computer.

Most of the time **BEEP** is encountered when using the 930A with the PCM interface (Option 930A-08E or -09E). Usually it is because you don't have the 930A hooked into a span, so it has no PCM input and wants to tell you. You can shut up the **BEEP** in this case by looping **PCM IN 1** to **PCM OUT 1**, and setting the 930A to **TERMINATE** and **INTERNAL** clock, which gives it a signal. The beep interval is now 4 seconds long. Pressing any front panel key will add another 4 seconds which enables you to set up the 930A in peace.

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3-10.10 HOW TO CHANGE THE TLP (MENU OPTION 30)

Menu Option Number: 30 **ADJUST TLP** lets you manually adjust the transmission level point (TLP) compensation of the 930A and is a standard feature. The Transmit TLP affects the level the 930A sends. The Receive TLP affects the level sensitivity of the 930A receiver. This function **is not** normally used when testing 2-wire analog, or PCM (T-Carrier), trunks since these are usually a 0 dB TLP.

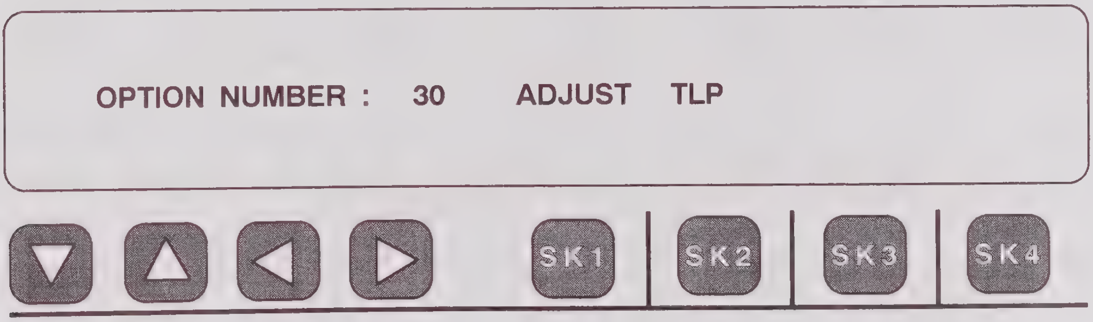
To set the TLP level of the transmit or receive section of the 930A, perform the following steps:

Press the OPTION MENU ■ ○ **Option Menu** function key.

Use the UP/DOWN ▽ △ arrow keys to

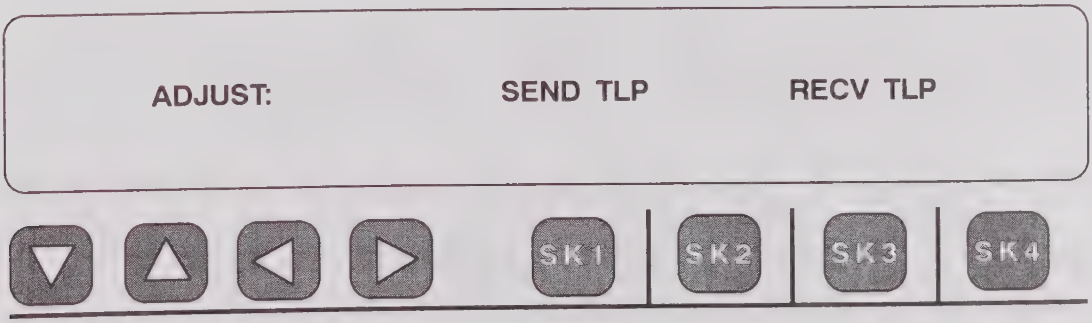
select Menu Option 30: ADJUST TLP.

The 930A display will appear as shown below:

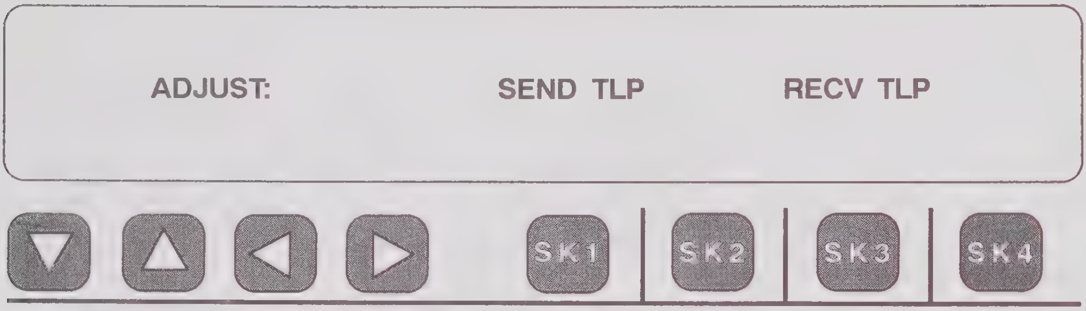


OPTION NUMBER : 30 ADJUST TLP

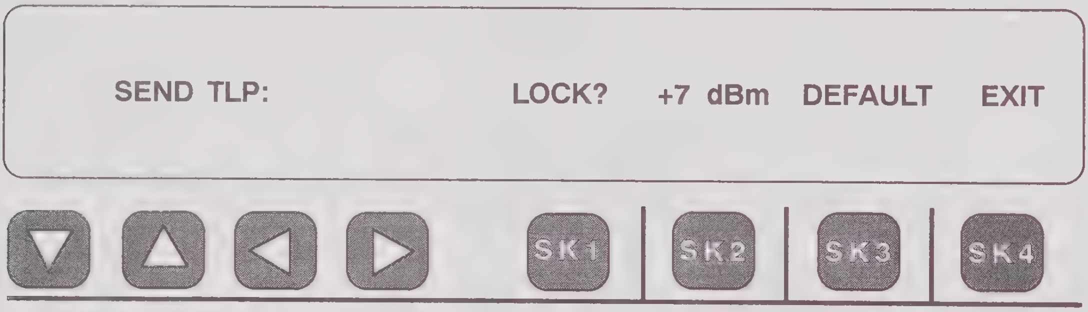
Pressing any softkey under the display will enter the menu. Once inside Menu Option 30, the display is:



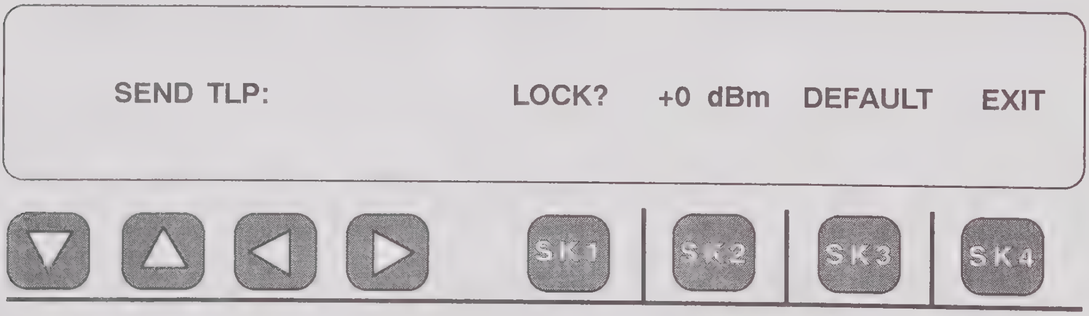
ADJUST: SEND TLP RECV TLP



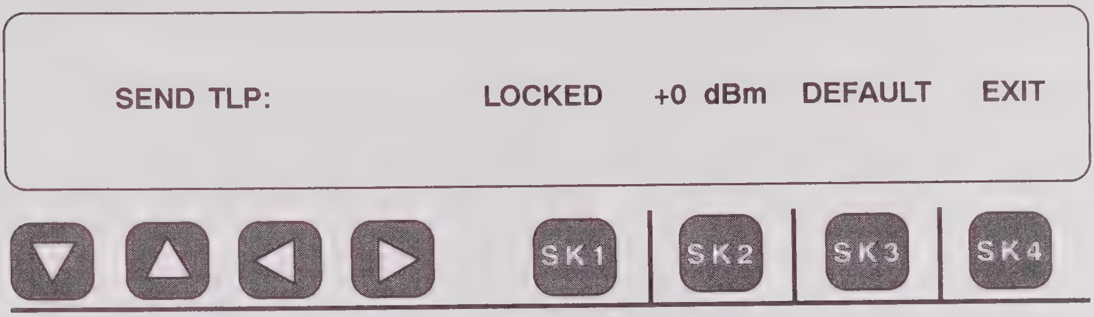
To adjust the Transmit **TLP**, press Softkey 1 (under **SEND TLP**) and the 930A display will show the current **TLP** setting. For example:



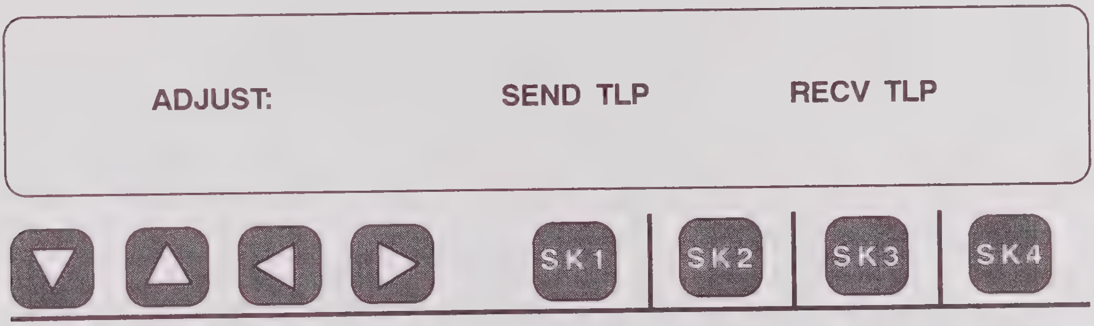
Here the previous **TLP** was +7 dB. The 930A also asks whether you want to lock in that value as the start-up default. This is what the "**LOCK?**" over Softkey 1 is asking you. You might want to reduce the **TLP** for some reason. Suppose you wanted to send at a 0 dB **TLP**. Just press **0** on the Numeric keypad and then **ENTER**. The display will change to:



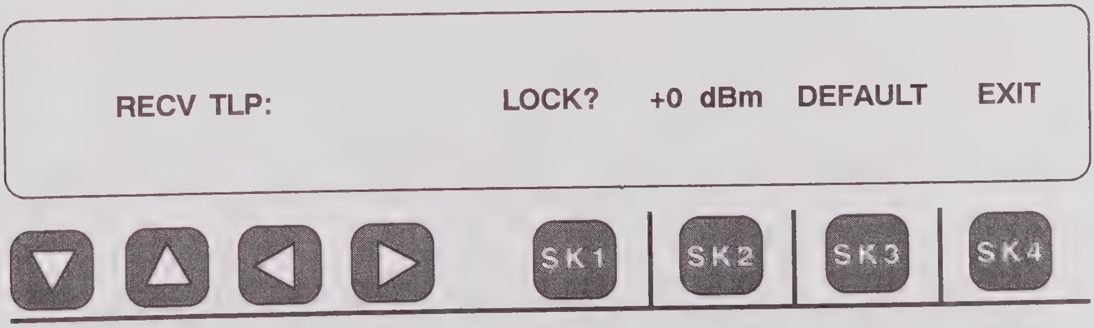
If you want this to be the new default value when you power up the 930A then press Softkey 1 and the display will indicate "**LOCKED.**" The 930A will alert you to the fact that the **TLP** is modified when you turn it on.



To return the 930A to the default **TLP** value for the Trunk Type selected, press Softkey 3 (under **DEFAULT**) and the 930A display will then show the appropriate value and unlock itself. Press Softkey 4 (under **EXIT**) to return to the **ADJUST** menu.



Changing the Receive TLP affects the level sensitivity of the 930A digit receiver. **To change the Receive TLP**, press Softkey 3 (under **RECV TLP**) and the display will become:



If the displayed **TLP** value (+0 dB in this example) is not what you want, just enter what you do want on the keypad and press **ENTER**. Just repeat the same procedure you used to change the **Send TLP**. The same is true for **LOCK**ing in the default value, selecting the **DEFAULT**, or **EXIT**ing.

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3-10.11 HOW TO SEND A HOOK FLASH (MENU OPTION 31)

Menu Option 31: **SEND HOOK FLASH** enables you to send a Hook Flash from the 930A. The length of the Hook Flash is nominally 200 milliseconds but is variable from 10 to 9999 milliseconds. This feature checks out a switch's, or PBX's, flash recognition capability.

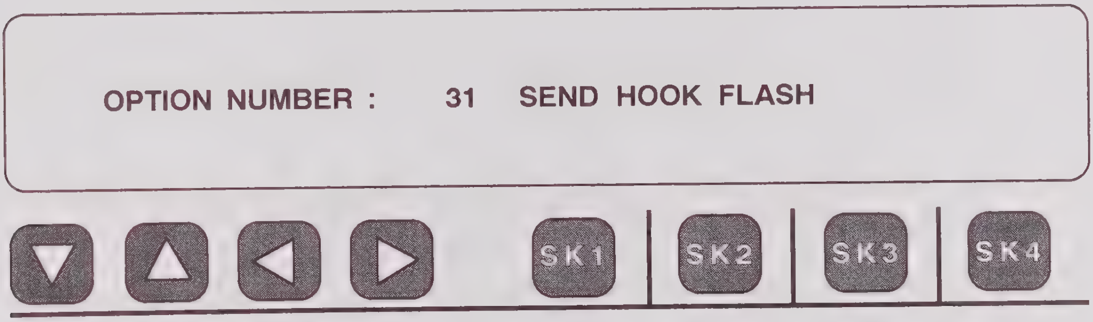
To use this feature, perform the following steps:

Press the OPTION MENU function key.

Use the UP/DOWN arrow keys to

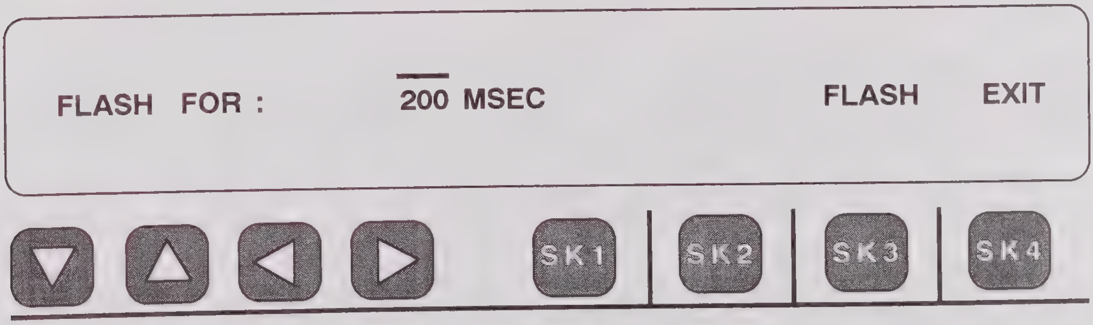
select Menu Option 31: SEND FLASH HOOK.

The display will appear as shown below:



```
OPTION NUMBER :    31   SEND HOOK FLASH
```

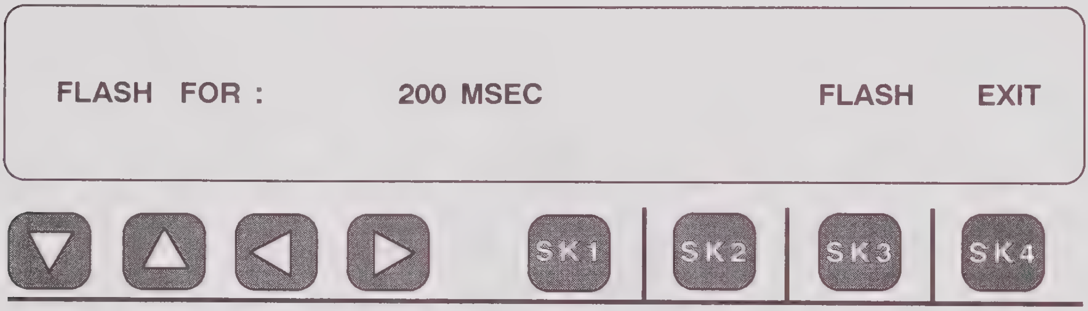
Pressing any softkey will bring up the main menu which is shown below:



```
FLASH  FOR :          200 MSEC              FLASH     EXIT
```

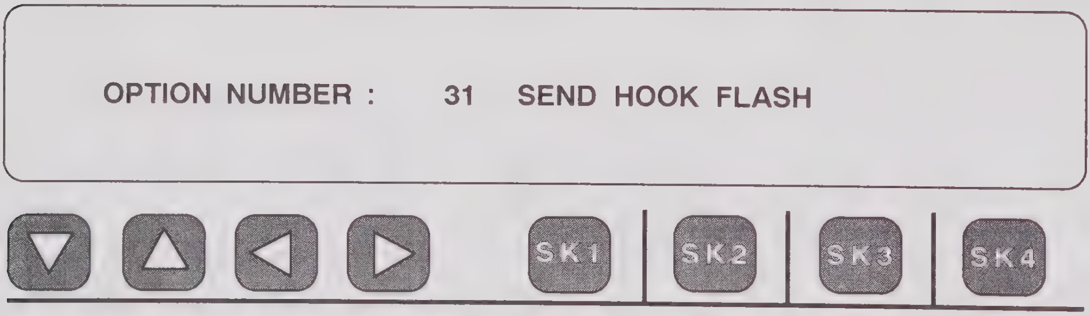
You can set any length flash you want from 10 milliseconds to 9999 milliseconds using the numeric keypad and the **ENTER** key. Bear in mind that very short duration flashes (< 50 msecs.) will not be indicated by the front panel supervision LEDs.

To send a hook flash of the displayed duration, you press Softkey 3 (under **FLASH**):


FLASH FOR : 200 MSEC

Pressing Softkey 3 would cause a 200 millisecond Hook Flash to be sent from the 930A on the analog trunk, or PCM channel (if Option 930A-08E or -09E is installed) selected. If the 930A is On Hook, pressing the **FLASH** softkey causes it to go Off Hook for the prescribed number of milliseconds. If the 930A is Off Hook, pressing the **FLASH** softkey causes the 930A to go On Hook during the flash.

To exit from this Menu Option, press Softkey 4 (under **EXIT**), or press the **OPTION MENU** key, and the display will return to:


OPTION NUMBER : 31 SEND HOOK FLASH

3-10.12 USING THE DIAL-UP TESTLINE (MENU OPTION 32)

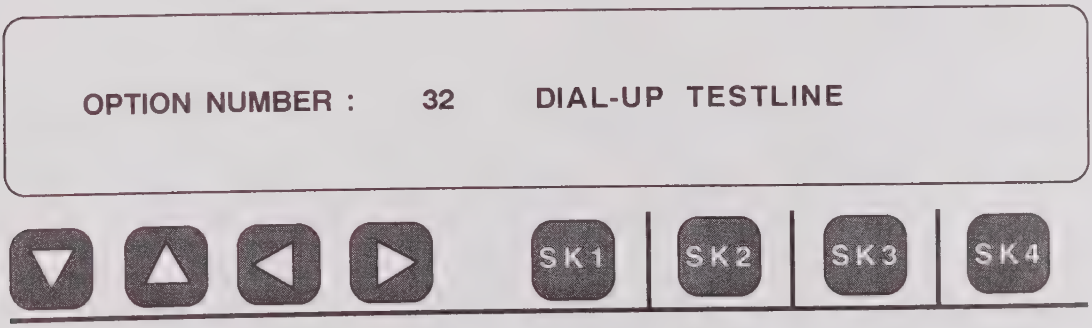
Menu Option 32: **DIAL-UP TESTLINE** lets the 930A provide Quiet Termination or send a tone in response to ringing or seizure. That is, the 930A can act as a Type 100 or a Type 102 Testline. This function is particularly useful for connection appraisal testing through a switch. You may test any number of trunks through a switch to a 930A which is connected to a single port. You could dial through the switch on a thousand different phone numbers to reach the 930A tied to that single point. When each call completed, the 930A could be set to respond with a 1004 Hz tone at whatever level was preset.

To use this feature you first set-up what tone you want sent or "Quiet Termination" using the **SEND TONE** function described in Section 3-7. A commonly sent tone is 1004 Hz at a 0 dBm level to simulate the "Milliwatt." If you turn off the Send Tone function, the 930A will supply "Quiet Termination." After you have set-up the **SEND TONE** function perform the following steps:

Press the OPTION MENU ■ ○ **Option Menu** function key.

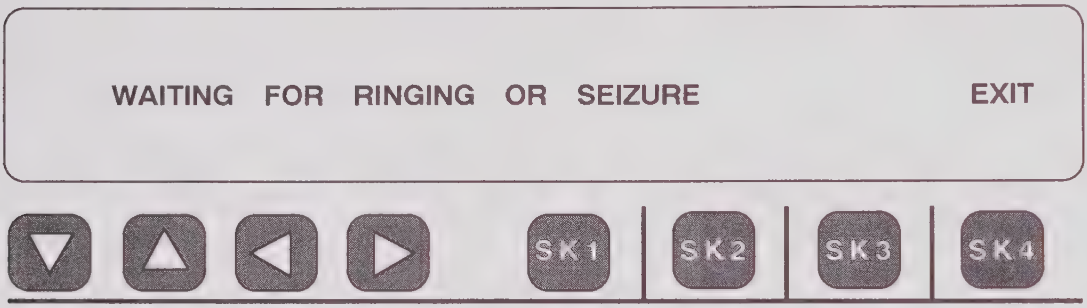
Use the UP/DOWN ▼ ▲ arrow keys to select Menu Option 32: DIAL-UP TESTLINE.

The 930A display will appear as shown below:



OPTION NUMBER : 32 DIAL-UP TESTLINE

Press any softkey to enter the menu option and the display will become:



Entering this menu places the 930A On Hook where it will remain waiting for ringing or line seizure before going Off Hook.

If the 930A tone generator has been turned **OFF** (refer to Section 3-7), then the 930A will provide Quiet Termination when ringing or seizure is detected.

If you have selected a particular tone, say 1004 Hz at 0 dBm, and left the tone generator turned **ON** prior to entering Menu Option 32, then the 930A will respond with the 1004 Hz at 0 dBm when ringing or seizure is detected.

This feature would be used mainly on Loop Start Trunk Types where the 930A is simulating the **CONTACT** side of the trunk but it could be used on any Trunk Type.

3-10.13 USING THE DIAL-UP SWEEP (MENU OPTION 33)

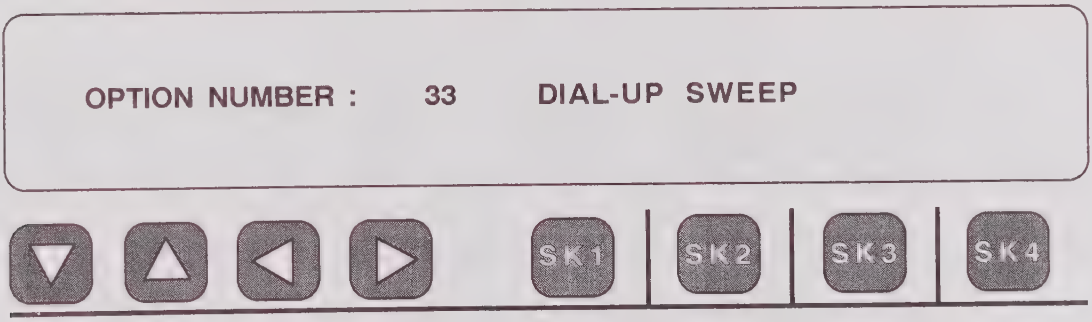
This standard feature operates exactly like the **DIAL-UP TESTLINE** function except that it sends back whatever Sweep parameters have been set in Menu Option 10: **FREQUENCY SWEEP**. This is particularly useful when you want to make an attenuation distortion measurement on a 2-wire trunk and there is no one available to test with you at the far-end. A 930A at the far-end can be set to send you whatever sweep parameters you want whenever you call it up.

To use this feature you **first** set the sweep up using Menu Option 10. The 930A default sweep is the one most often used for attenuation distortion measurement, so normally you do not need to do this unless you have changed the factory defaults. **Next**, you do the following:

Press the OPTION MENU ○ **Option Menu** function key.

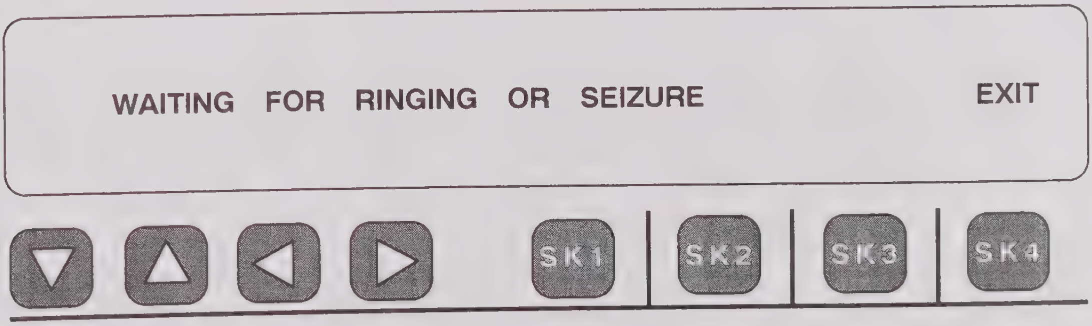
Use the UP/DOWN ▽ △ arrow keys to

select Menu Option 33: DIAL-UP SWEEP.



OPTION NUMBER : 33 DIAL-UP SWEEP

Enter the menu by pressing any of the softkeys below the display and you will see:



WAITING FOR RINGING OR SEIZURE **EXIT**

When the 930A receives ringing, or sees a seizure on the trunk, it will begin sending the sweep frequencies back. This will continue until the trunk is disconnected (goes back On Hook). The 930A will do this as long as it is left in this menu.

Pressing Softkey 4 will **EXIT** from the menu and stop any sweep in progress.

3-10.14 DSP MEMORY TEST (MENU OPTION 90)

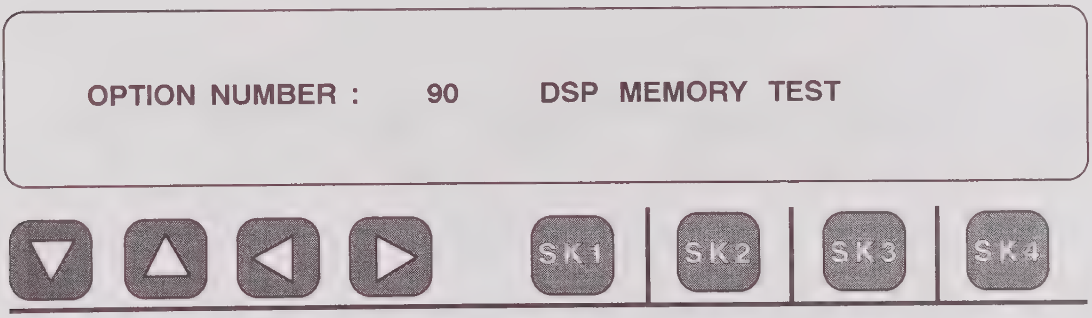
This menu is more useful to SAGE than to the customer. It is used during our manufacturing process. It checks the health of the memory on the DSP board in the 930A if you have purchased Option 930A-01. If you get strange test results in the digit receiver/analyzer even after a **"Cold Boot,"** this would be another place to check.

You get to this menu like you do the others.

Press the OPTION MENU ■ ○ **Option Menu** function key.

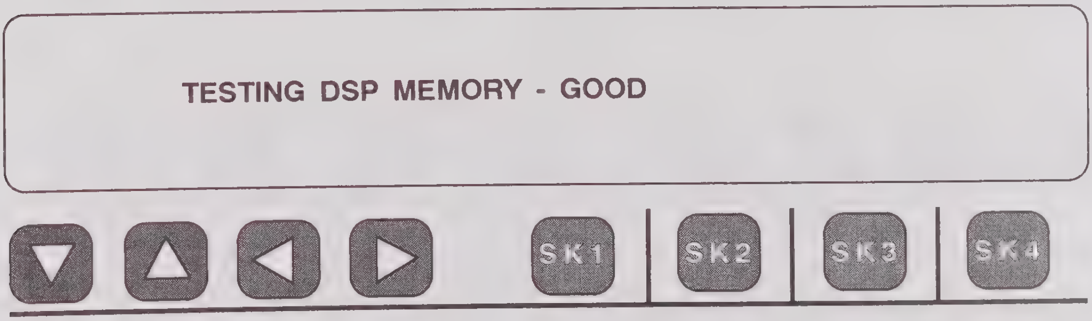
Use the UP/DOWN ▽ △ arrow keys to

select Menu Option 90: DSP MEMORY TEST



OPTION NUMBER : 90 DSP MEMORY TEST

When you enter this menu you will see the following display, if all is well:



TESTING DSP MEMORY - GOOD

If you do not get this display, then you should call SAGE customer service at (408)761-1000. Again, **this menu only applies if you have Option 930A-01**.

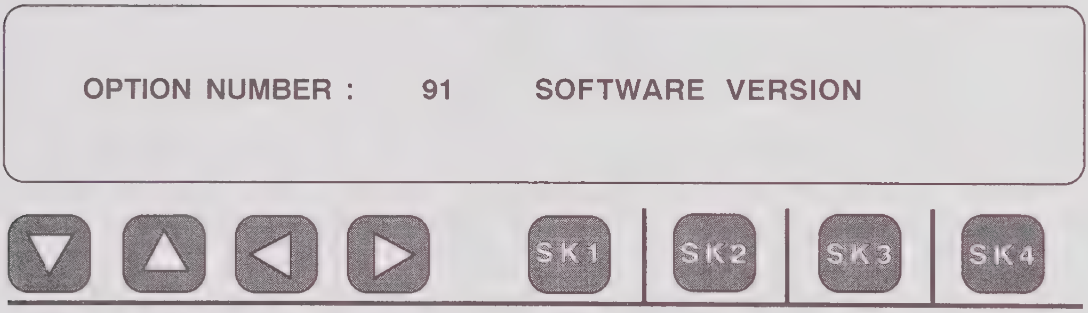
3-10.15 WHERE TO FIND SOFTWARE VERSION (MENU OPTION 91)

You can turn the 930A off and then on again to determine the software level you have in the unit. But this is usually inconvenient so you can now go to Menu Option 91: **SOFTWARE VERSION** by doing the following:

Press the OPTION MENU function key.

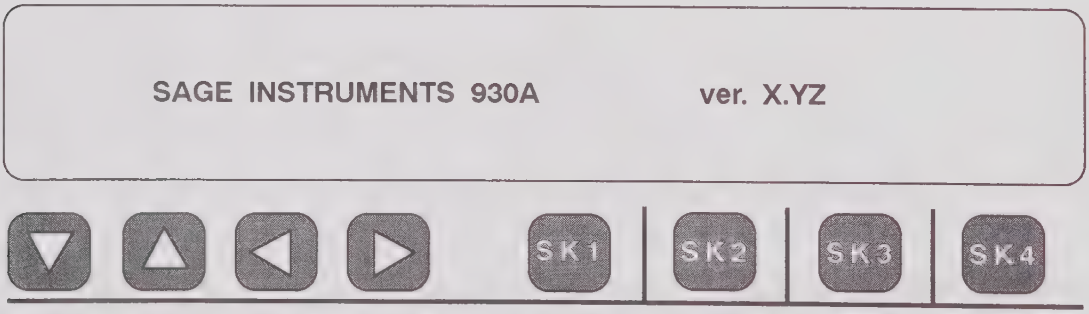
Use the UP/DOWN ▽ △ arrow keys to

select Menu Option 91: SOFTWARE VERSION.



OPTION NUMBER : 91 SOFTWARE VERSION

When you press any softkey under the display, you will see the version of software you have in your 930A.



SAGE INSTRUMENTS 930A ver. X.YZ

The operating system software in the 930A is updated from time to time. Upgrades to the current software version are free to the original owners for life. You may call SAGE Customer Service from time to time to see if you need to upgrade from your existing system. Usually this is not necessary unless we have added something to the list of standard features that your software does not have.

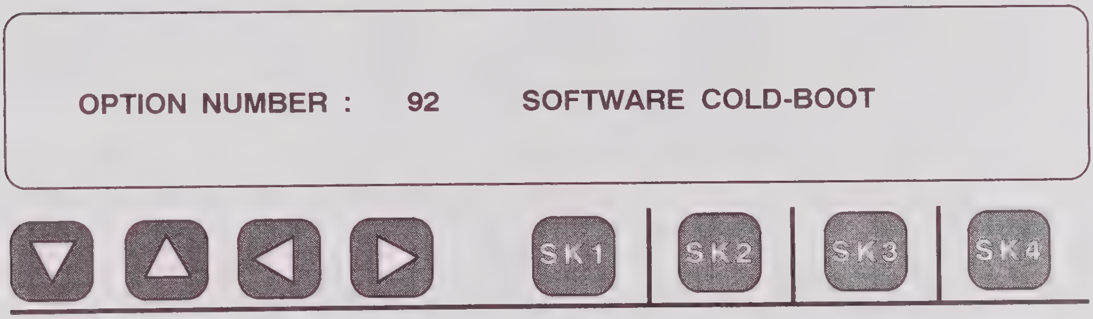
3-10.16 HOW TO DO A SOFTWARE COLD-BOOT (MENU OPTION 92)

Rather than doing a full Hardware Cold-Boot such as you would do when you change software in the 930A, you can do a Software Cold-Boot which is useful in restoring the 930A to its factory default settings. Someone else may use your 930A from time to time and may set in parameters that will affect your readings. This is a convenient way of starting from scratch so to speak. **The Software Cold-Boot does not affect the Remote Control settings (Menu Option 3).**

Press the OPTION MENU ○ **Option Menu** function key.

Use the UP/DOWN ▽ △ arrow keys to

select Menu Option 92: SOFTWARE COLD-BOOT.



OPTION NUMBER : 92 SOFTWARE COLD-BOOT

WARNING! Once you press any softkey and enter this menu you will Cold-Boot the 930A. All memories will be erased and the factory defaults will be restored. The 930A will return to the 2-wire LOOP START Trunk Type default.

If you do not want to do this, then go to some other Menu Option and do not enter the one above. **Never enter this menu when the 930A is connected to a circuit.**

3-10.17 THE TEST DISPLAY (MENU OPTION 93)

This Menu Option is mainly used during manufacturing to test the display and the LEDs by turning everything on.

To get out of this menu, if you have entered it, just press the **OPTION MENU** key and you will get outside again.

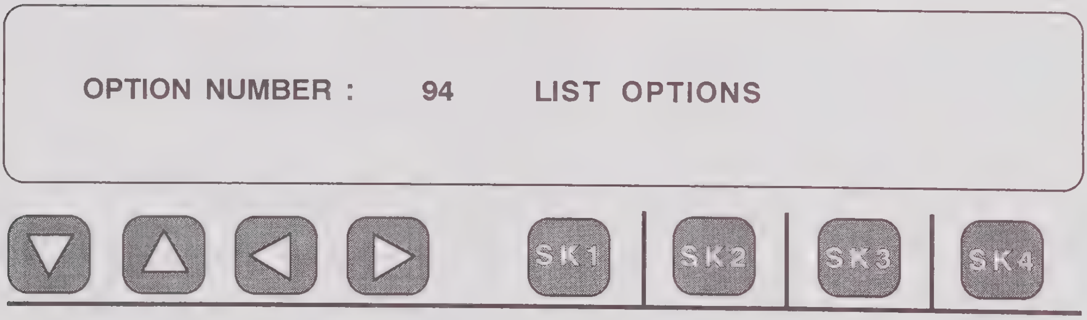
3-10.18 HOW TO FIND OUT WHAT OPTIONS ARE INSTALLED IN YOUR 930A (MENU OPTION 94)

Menu Option 94: **LIST OPTIONS** tells you what purchased options you have in your 930A. You get to it by the following steps.

Press the OPTION MENU ○ Option Menu function key.

Use the UP/DOWN ▽ △ arrow keys to

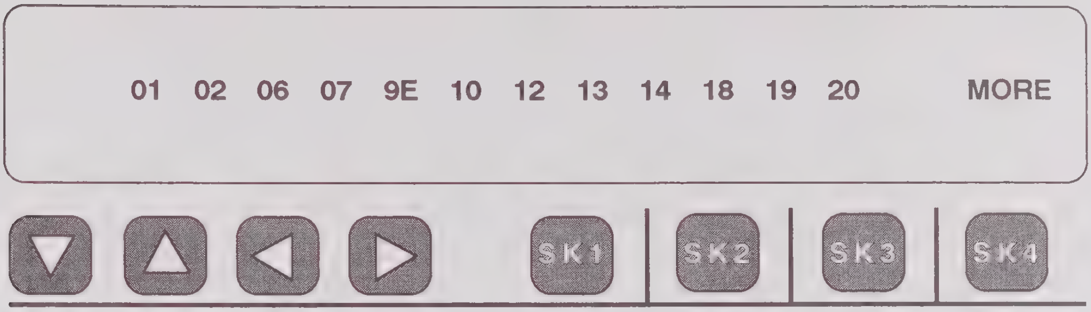
select Menu Option 94: LIST OPTIONS.



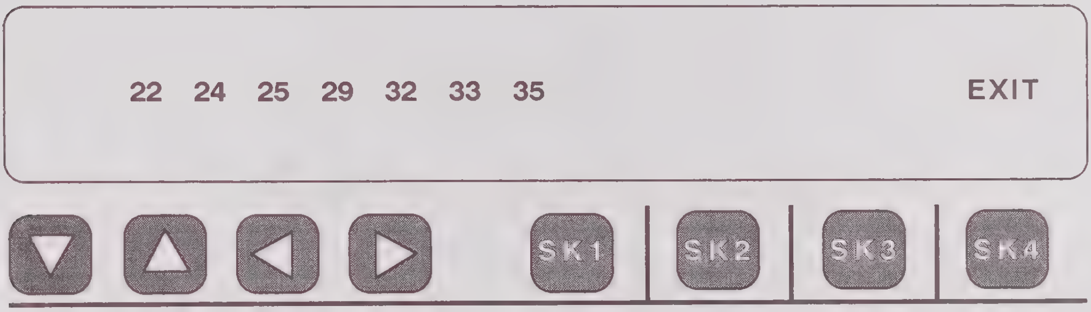
OPTION NUMBER : 94 LIST OPTIONS

Once you get to this menu, press any of the softkeys below the display and the 930A will show you a screen such as the one on the following page.

Remember: The purchased option numbers do not match the Menu Option numbers. Refer to Table 4-1, on pages 4-3 and 4-4 in the next section, to match the purchased option numbers with their locations under the Option Menu Function key.



Pressing Softkey 4 (under **MORE**) would show the rest of the options such as:



A 930A equipped with all these options could be said to be fully loaded. In fact, most 930As are not equipped with all of the available options by their owners. They are tailored to specific applications and once you have the basic 930A you can option it to your specific test requirements. The Switching groups usually order Options 930A-01, -07, -09E, -10C, -12 and -25. The Special Services and Transmission people usually order Options 930A-06, -07, -09E, -10C, -18, -19, and -20. Network Technical Support orders everything, including options we don't have. Facility Maintenance usually orders Options 930A-09E, -10C, and -22 as a minimum. However, as the distinction between Trunk and Facility testing blurs, we see the test sets being more heavily optioned as the testing requirements of the modern network change.

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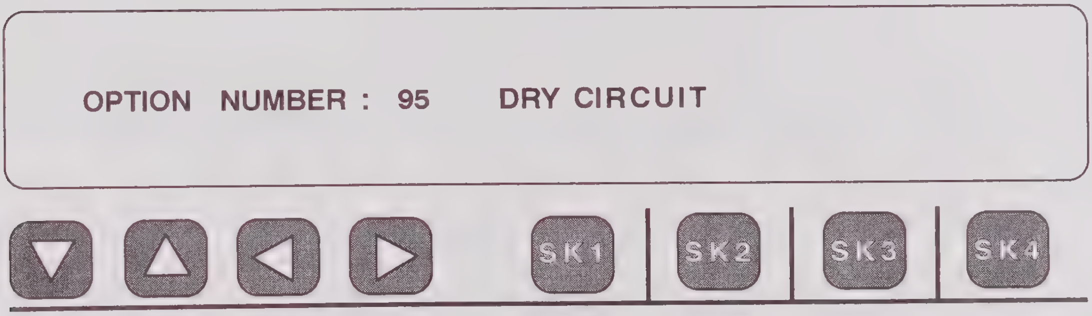
3-10.19 HOW TO TEST DRY CIRCUITS WITH THE 930A (MENU OPTION 95)

The 930A normally expects to see supervision on the trunks it is testing. However, there are trunks that have no supervision on them. These are usually dedicated lines found in special services point-to-point applications. When you encounter these types of circuits you can place the 930A in a mode that removes supervision.

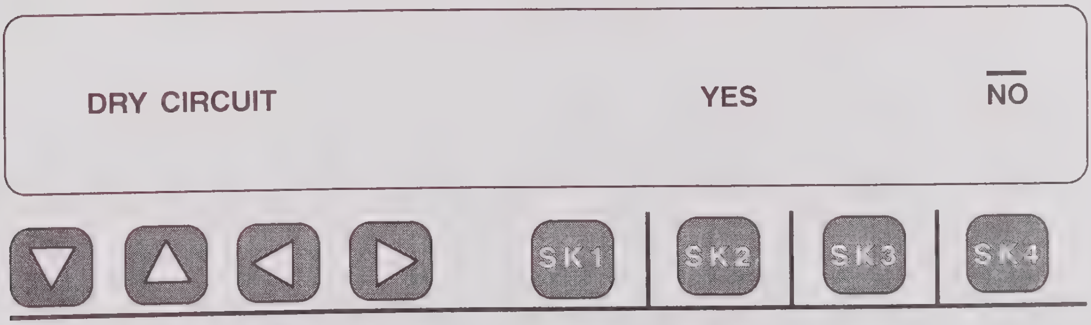
Press the OPTION MENU

function key.

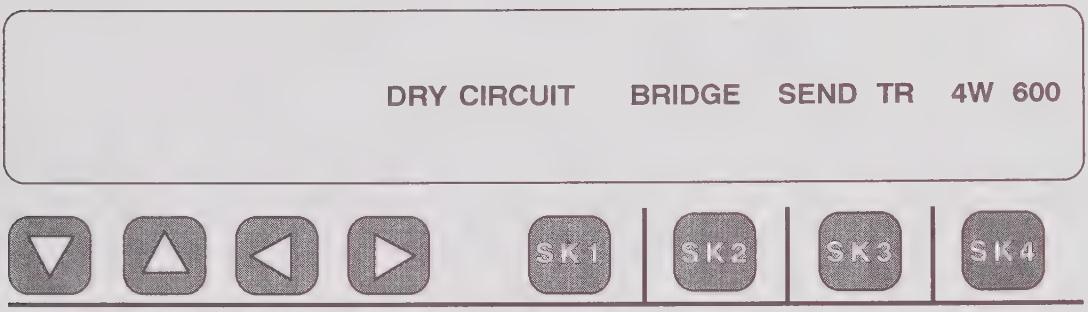
Use the UP/DOWN arrow keys to select Menu Option 95: DRY CIRCUIT.


OPTION NUMBER : 95 DRY CIRCUIT

Press any softkey and the display will show:


DRY CIRCUIT YES $\overline{\text{NO}}$

Press Softkey 2 under **YES** and the 930A will set the **TRUNK TYPE** to a Dry Circuit. The display will change to that shown on the following page.



DRY CIRCUIT BRIDGE SEND TR 4W 600

Press Softkey 4 (under **4W 600** above) to select 2-Wire or 4-Wire operation and impedances of 150 ohms, 600 ohms, 900 ohms or 1200 ohms.

Press Softkey 2 under **BRIDGE** to select **TERMINATE,** or vice versa.

Once you have set the correct impedance and operating condition, you just use the other functions (such as **SEND TONE** or **MEASURE TONE**) as you would with any other **TRUNK TYPE**.

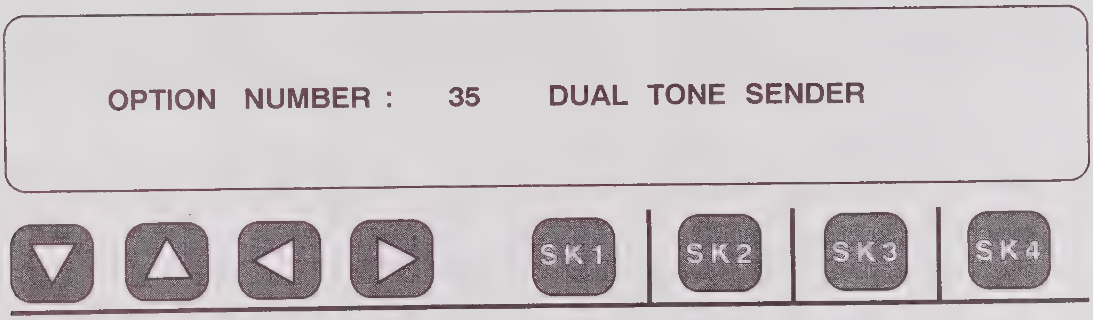
Pressing Softkey 1 in the display above will cause the 930A to exit from this Trunk Type. You can re-enter this mode, or exit from it at any time, by returning to Menu Option 95 and pressing Softkey 4 under **NO**.

3-10.20 SENDING DIAL-TONE, BUSY AND OTHER DUAL TONE SIGNALS (MENU OPTION 35)

The 930A is capable of sending any dual tone signal whose two tones fall within the 930A frequency range. For the convenience of the user, the 930A has several preset signals. These are Dial-Tone, Busy and Reorder. But you can input any two tones you wish and set their levels and their on and off times as well. The following steps outline the procedure for using this menu option.

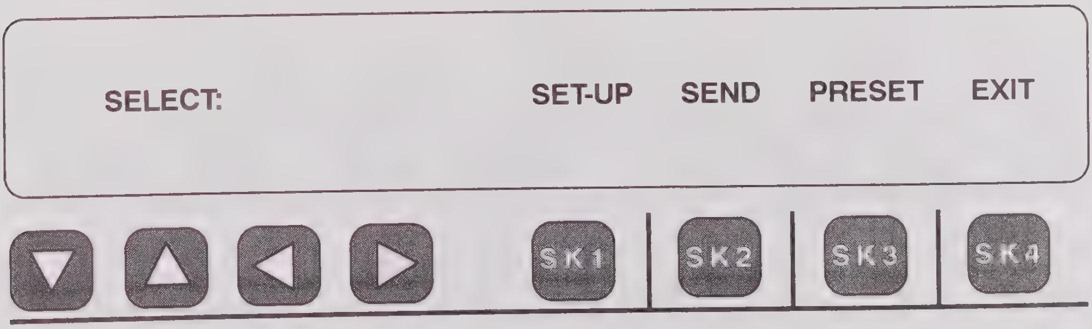
Press the OPTION MENU ■ ○ Option Menu function key.

Use the UP/DOWN ▽ △ arrow keys to select Menu Option 35: DUAL TONE SENDER.

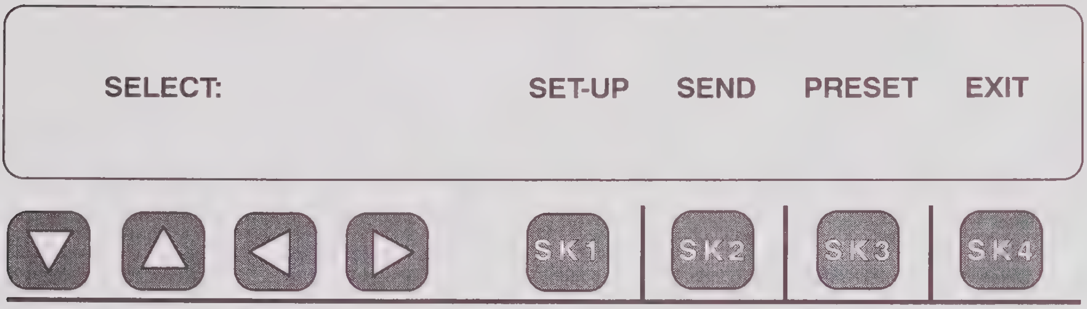


OPTION NUMBER : 35 DUAL TONE SENDER

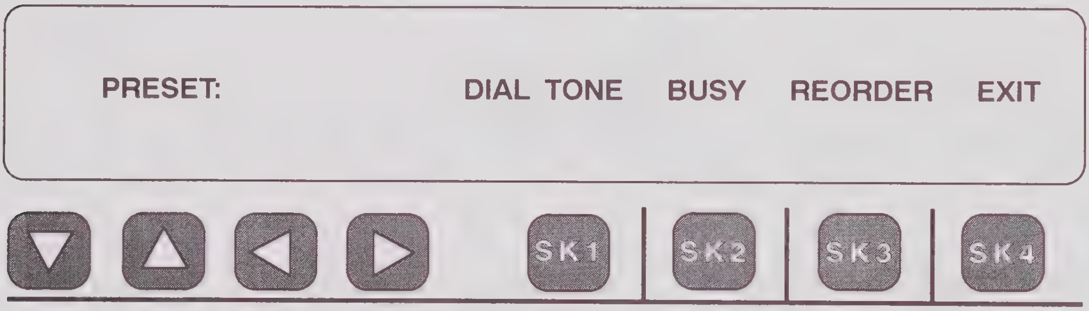
Press any softkey and the main SELECT display will appear.



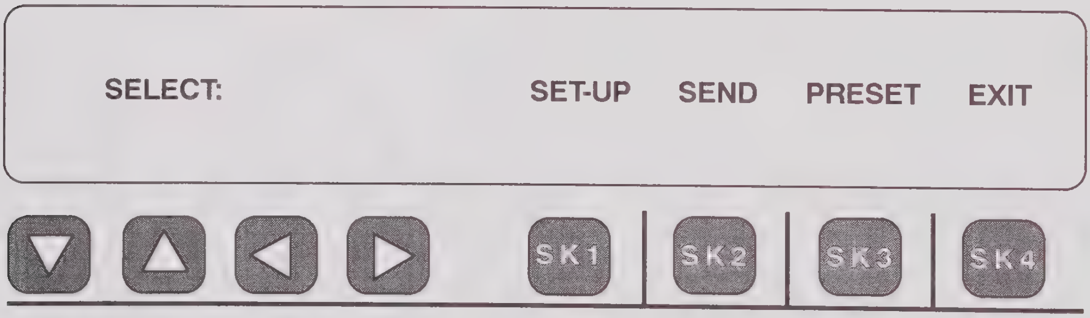
SELECT: SET-UP SEND PRESET EXIT



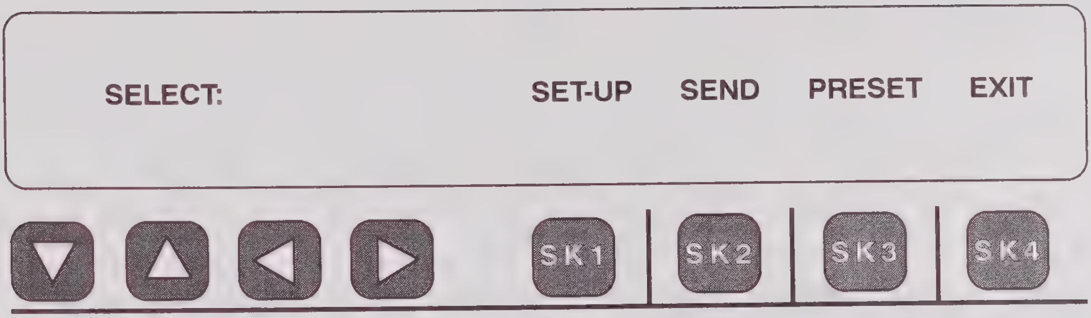
To select and send a standard preset signal such as Dial Tone, Busy or Reorder press Softkey 3 under PRESET. The display becomes:



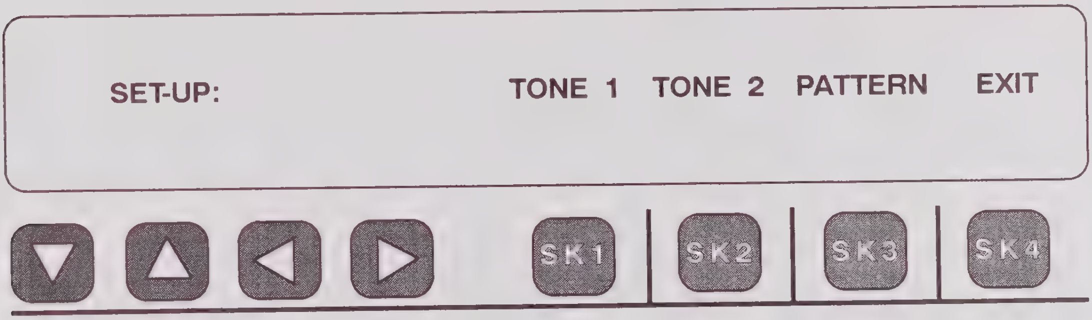
Make your selection by pressing the softkey directly below the tones you want to send. For instance, pressing Softkey 2 under BUSY will select the trunk busy signal. Once you have made your selection you will be returned to the main SELECT menu.



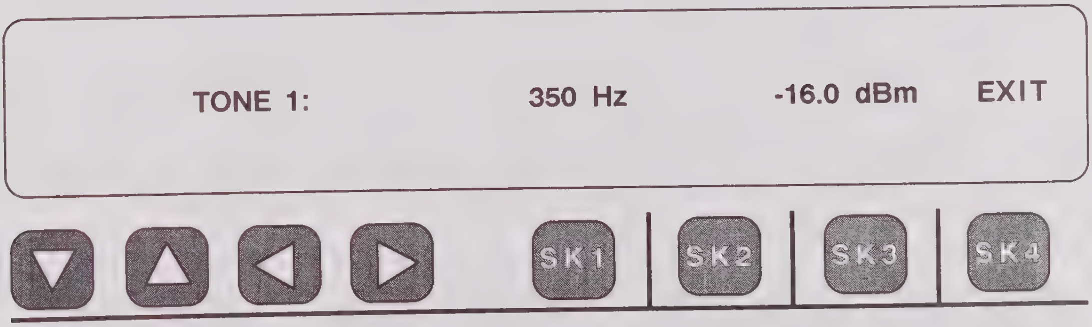
At this point, press Softkey 2 under SEND to begin sending the tones you selected. A flashing cursor will appear over SEND while you are transmitting. To stop sending, press Softkey 2 again or press Softkey 4 under EXIT.



To send a two tone signal other than the PRESET tones, use the SET-UP menu. Press Softkey 1 to enter the SET-UP display.

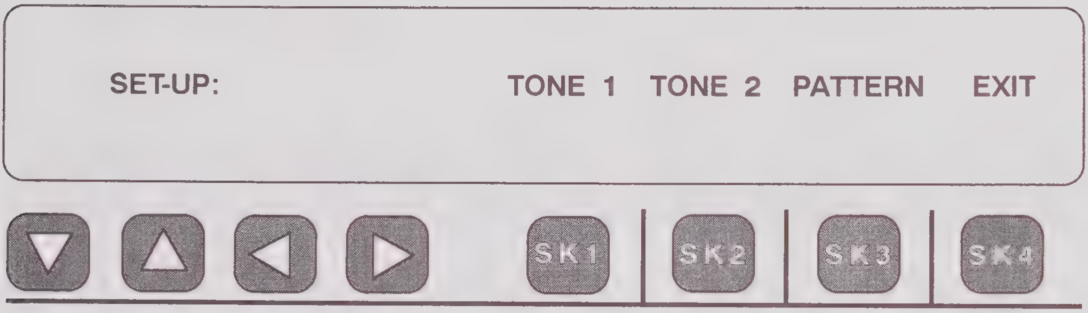


Begin by setting the level and frequency of TONE 1. To do this, press Softkey 1 under TONE 1. A display similar to the following will appear:

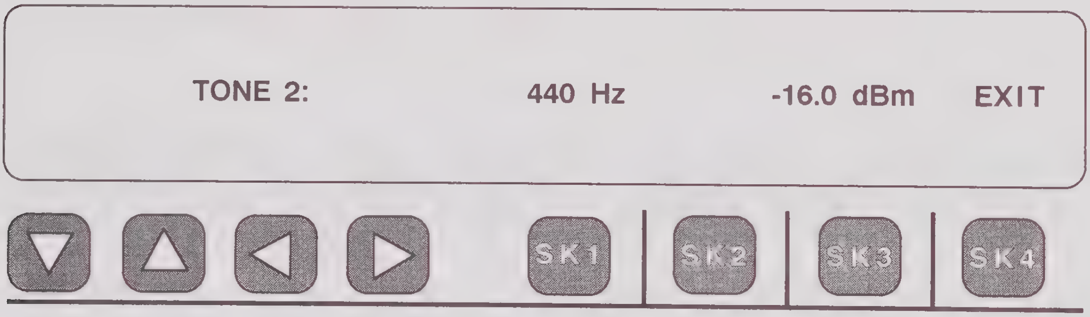


To change the frequency of the tone press Softkey 1 (under 350 Hz in this example) and then enter the desired frequency from the keypad. Press the ENTER key to complete the selection.

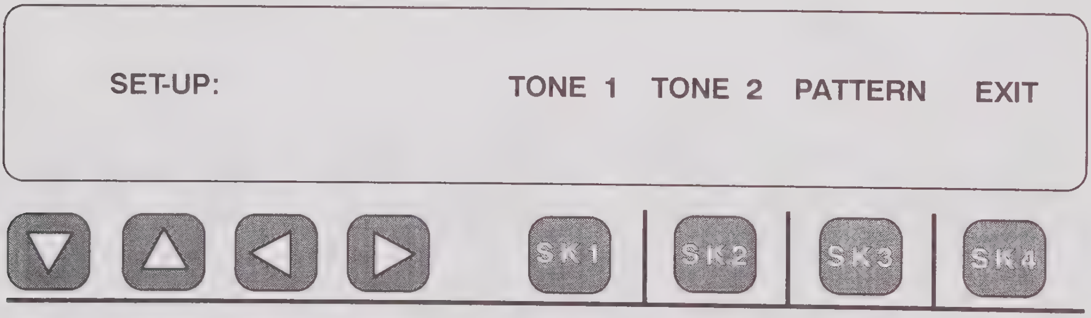
To change the level of the tone press Softkey 3 (under -16.0 dBm in this example) and then enter the desired level from the keypad. Press the ENTER key to complete the selection. Press Softkey 4 under EXIT to return to the main set-up menu.



To change the level and frequency of TONE 2 press Softkey 2 and a display like the one below will appear.

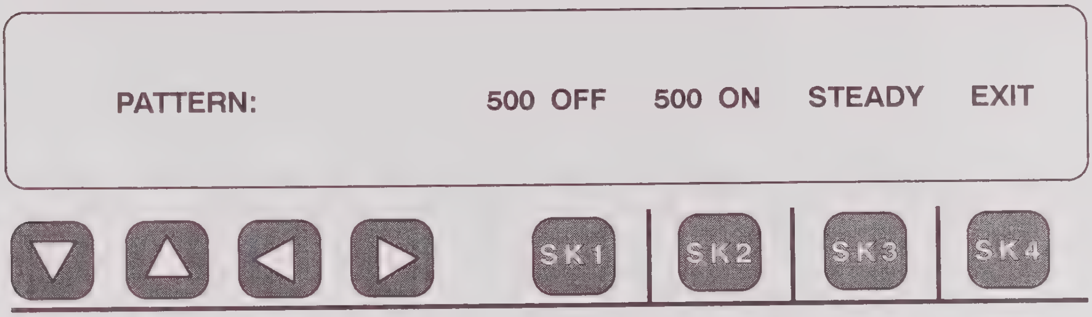


Repeat the procedure previously outlined for TONE 1 to modify TONE 2. When you have set TONE 2, press Softkey 4 to exit back to the SET-UP menu.



You are now ready to change the timing or pattern of the dual tone signal.

To change the Pattern, press Softkey 3 under PATTERN and the display will change to:



You can set the time your tones will be on and off or you can have them transmit steadily. For example, Dial Tone is sent continuously or STEADY. Busy is sent at 0.5 seconds ON and 0.5 seconds OFF as shown above. The display shows time in milliseconds so 0.5 seconds is shown as 500 milliseconds.

To change the ON and OFF times, press Softkey 1 under OFF and enter the desired time using the keypad and then press Softkey 2 under ON to change the on time.

To send a signal continuously, press Softkey 3 under STEADY and then press Softkey 2 under SEND in the SELECT menu. Notice that in this case the ON and OFF times are blank.

When you have made your selections, press Softkey 4 to exit.

To send your creation, press Softkey 2 under SEND in the SELECT menu just as you did for PRESET tones.

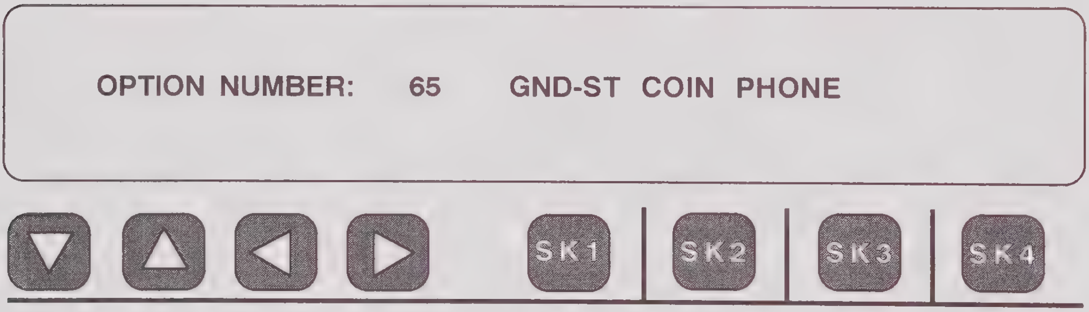
3-10.21 SETTING THE 930A TO WORK ON GROUND START COIN PHONE TRUNKS (MENU OPTION 65)

If you have occasion to use the 930A on Coin Phone trunks you will sooner or later encounter Ground Start trunks. While the 930A does provide ordinary Ground Start supervision under the TRUNK TYPE menu this is not enough when dealing with coin phone circuits. Menu Option 65: GND-ST COIN PHONE was added to the 930A to take care of this special case of Ground Start. You must first set the 930A TRUNK TYPE to the appropriate Ground Start trunk settings. Then do the following:

Press the OPTION MENU function key.

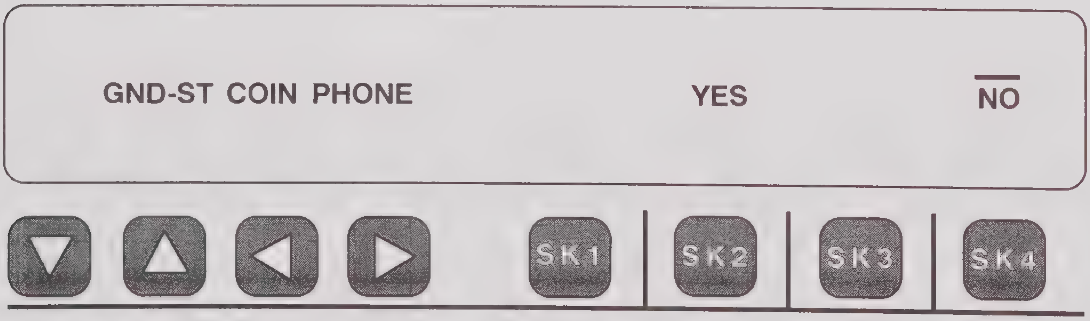
Use the UP/DOWN arrow keys to

select Menu Option 65: GND-ST COIN PHONE.



OPTION NUMBER: 65 GND-ST COIN PHONE

Press any softkey under the display to get to the main menu:



GND-ST COIN PHONE YES $\overline{\text{NO}}$

Press Softkey 2 under YES to place the 930A in the coin phone mode. The 930A functions and menu options continue to operate as usual.

SECTION IV
OPTIONS

4-1 INTRODUCTION

The Model 930A may be equipped with a number of **optional features** which expand and enhance its test and measurement capabilities. This section describes the **operation** of the Model 930A when equipped with these available **options**.

This list shows the currently available options for the Model 930A. A N/A indicates that there is no write up needed for the option.

OPTION	DESCRIPTION	SECTION
930A-01	MF/DTMF/DP Receiver and Analyzer	4-2
930A-02	SF Supervision	4-3
930A-06	P/AR Measurement	4-4
930A-07	3-Level Impulse Noise	4-5
930A-08E	Single Direction DS-1 PCM Access	Sect. VI
930A-09E	Dual Direction DS-1 Drop and Insert	Sect. VI
930A-10C	RS-232C Remote Control/Printer Interface with Real Time Clock (Covered in Section V).	Sect. V
930A-12	ROTL/Near End Responder/Far End Responder (Type 105 Compatible) (Requires Option 930A-01).	4-6
930A-13	Ring Generator/REN-3 Load	4-7
930A-14	LTTP/STTP (1/1A ESS) Interface	N/A
930A-16	-48 VDC Power Supply	N/A
930A-17	Removes 2W/4W Metallic Interface (Requires Option 930A-08E or -09E)	N/A
930A-18	Phase Jitter/Hits (Requires Option 930A-07)	4-8
930A-19	Envelope Delay Distortion	4-9
930A-20*	4-Tone Intermodulation Distortion	4-10
930A-22	DS-1/DS-0 Bit Error Rate Testing (Requires Option 930A-08E or -09E)	6-17

* Licensed under Hekimian Laboratories Patent No. 3,862,380

OPTION	DESCRIPTION	SECTION
930A-25	FXO/FXS Supervision (Requires Option 930A-08E or -09E)	6-12
930A-27	Digital Switch Corporation Software	N/A
930A-29	Batch Mode Testing	4-11
930A-32	64K RAM Buffer (Used with Option 930A-29)	N/A
930A-35	Near End Responder/Interrogator for HLI Type 125 Far End Responders (Requires Option 930A-01)	4-12
930A-36	Extends Warranty to 3 years	N/A

This part of the manual is organized by option number and proceeds in order from Option 930A-01. The exceptions to this rule are: Option 930A-10C which is described in Section V, **REMOTE CONTROL OPERATION**, Options 930A-08E, -09E and -22 which are described in Section VI, **T-CARRIER MEASUREMENTS** and Options 930A-14, -16, -17, -27 and -36 which are self-explanatory.

To prevent possible confusion between purchased option numbers and the Option Menu numbers, Table 4-1 provides a cross reference.

TABLE 4-1
MENU OPTION NUMBERS

MENU OPTION NUMBER	DESCRIPTION	PURCHASED OPTION
OPTION NUMBER: 1	MODIFY DIAL/RING	STANDARD
OPTION NUMBER: 2	SEND DIGIT SEQUENCES	STANDARD
OPTION NUMBER: 3	REMOTE CONTROL	OPTION 930A-10C
OPTION NUMBER: 4	DIGIT RECEIVER	OPTION 930A-01
OPTION NUMBER: 5	REN-3 LOAD	OPTION 930A-13
OPTION NUMBER: 6	D.C. VOLT/AMP METER	STANDARD
OPTION NUMBER: 7	SUPERVISION THRESHOLDS	STANDARD
OPTION NUMBER: 8	SUPERVISION MONITOR	STANDARD
OPTION NUMBER: 9	WINK TIMING	STANDARD
OPTION NUMBER: 10	FREQUENCY SWEEP	STANDARD
OPTION NUMBER: 11	IMPULSE NOISE & HITS	OPTION 930A-07
OPTION NUMBER: 12	WINK MARGINING	OPTION 930A-01
OPTION NUMBER: 13	PHASE/AMPLITUDE JITTER	OPTION 930A-18
OPTION NUMBER: 14	SET TIME AND DATE	OPTION 930A-10C
OPTION NUMBER: 15	BEEP ON ERROR	STANDARD
OPTION NUMBER: 16	RESERVED	
OPTION NUMBER: 17	ENVELOPE DELAY DISTORTION	OPTION 930A-19
OPTION NUMBER: 18	PEAK/AVERAGE RATIO	OPTION 930A-06
OPTION NUMBER: 19	4-TONE INTERMODULATION	OPTION 930A-20
OPTION NUMBER: 20	24 BIT DISPLAY	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 21	TOGGLE A/B BITS	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 22	RESERVED	
OPTION NUMBER: 23	RESERVED	
OPTION NUMBER: 24	RESERVED	
OPTION NUMBER: 25	FAR END RESPONDER	OPTION 930A-12
OPTION NUMBER: 26	ROTL/NEAR END RESPONDER	OPTION 930A-12
OPTION NUMBER: 27	ROTL INTERROGATOR	OPTION 930A-12
OPTION NUMBER: 28	TRANSPONDER TEST	OPTION 930A-35
OPTION NUMBER: 29	CALL 102 LINE	OPTION 930A-29
OPTION NUMBER: 30	ADJUST TLP	STANDARD
OPTION NUMBER: 31	SEND HOOK FLASH	STANDARD
OPTION NUMBER: 32	DIAL-UP TESTLINE	STANDARD
OPTION NUMBER: 33	DIAL-UP SWEEP	STANDARD
OPTION NUMBER: 34	SELECT REPORTS	OPTION 930A-10C

TABLE 4-1 (Continued)
MENU OPTION NUMBERS

MENU OPTION NUMBER	DESCRIPTION	PURCHASED OPTION
OPTION NUMBER: 35	DUAL TONE SENDER	STANDARD
OPTION NUMBER: 37	LINE STATUS	OPTION 930A-10C
OPTION NUMBER: 40	SEND PCM ALARMS	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 41	READ T1 VOLTAGE	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 42	T1 WANDER	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 43	ERROR COUNTERS	OPTION 930A-08E OPTION 930A-09E
OPTION NUMBER: 44	T1 ERROR HISTORY	OPTION 930A-09E
OPTION NUMBER: 45	T1 ERROR INJECT	OPTION 930A-09E
OPTION NUMBER: 46	DS-1 BIT ERROR RATE	OPTION 930A-22
OPTION NUMBER: 47	APS TEST	OPTION 930A-22
OPTION NUMBER: 50	BATCH MODE	OPTION 930A-29
OPTION NUMBER: 51	TEST RESULTS	OPTION 930A-29
OPTION NUMBER: 52	E911 EMULATION	OPTION 930A-37
OPTION NUMBER: 56	DS-0 BIT ERROR RATE	OPTION 930A-22
OPTION NUMBER: 57	DS-O LOOPBACK	OPTION 930A-22
OPTION NUMBER: 65	GND-ST COIN PHONE	STANDARD
OPTION NUMBER: 89	PRINTER HAND SHAKE	OPTION 930A-10C
OPTION NUMBER: 90	DSP MEMORY TEST	STANDARD
OPTION NUMBER: 91	SOFTWARE VERSION	STANDARD
OPTION NUMBER: 92	SOFTWARE COLD-BOOT	STANDARD
OPTION NUMBER: 93	TEST DISPLAY	STANDARD
OPTION NUMBER: 94	LIST OPTIONS	STANDARD
OPTION NUMBER: 95	DRY CIRCUIT	STANDARD
OPTION NUMBER: 96	TEST EXTENDED RAM	OPTION 930A-32
OPTION NUMBER: 97	HOLD CONTROL	STANDARD

Menu Option Numbers which are not used are reserved for future expansion.

4-1.1 USEFUL TRUNK TYPE/MENU OPTION COMBINATIONS

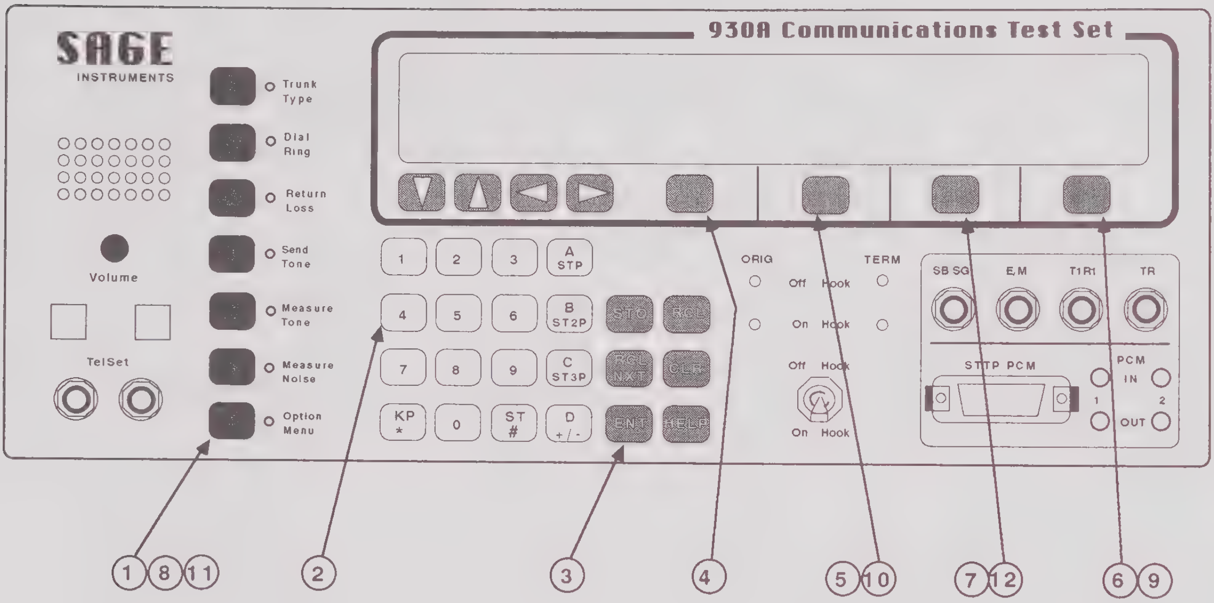
A frequently asked question is "What tests can I do when I am in a particular Trunk Type?". This section provides a quick guide to the menu numbers of the functions you will need for the most common tests. There are many others as well, but these are commonly used.

On Loop Start, Ground Start, E&M, SF, and T-1 PCM Trunks

TO	GO TO	SECTION
Place a Feature Group D, TSPS or any Wink Start call	**DIAL/RING** and Menu Option 2	3-5 and 3-10.3
Receive a call	Menu Option 4	4-2
Set-up Printer Port	Menu Option 3	5-2
Measure Wink Timing	Menu Option 2 or 4 to set-up and then Menu Option 9 for results.	3-10.3 4-2 3-10.7
Measure Supervision Timing	Menu Option 8	3-10.6 3-10.6.2

On T-1 PCM Trunks Only

TO	GO TO	SECTION
Check A, B, C & D Bits in all 24 Channels	Menu Option 20	6-8
Monitor a T-1 span for Slips, Errors, etc.	Menu Option 43	6-6
Measure T-1 Voltage	Menu Option 41	6-7
Check Clock Difference on a T-1	Menu Option 42	6-14
Make a T-1 Bit Error Test	Menu Option 45	6-15
Check 24 Hour Error History	Menu Option 44	6-15
Inject Errors, BPV's, etc.	Menu Option 46	6-15



To Receive and Analyze **MF**, **DTMF**, or **DP** Sequences:

1. Press the **OPTION MENU** function key.
2. Press the number 4.
3. Press the **ENT** (Enter) key to initiate Menu Option 4: **DIGIT RECEIVER**.
4. Press Softkey 1 to select the **SET-UP** menu.
5. Press Softkey 2 to set the Receive Parameters.
6. Press Softkey 4 to Exit back to the **SET-UP** menu.
7. Press Softkey 3 to set the Receive Sequence.
8. Press the **OPTION MENU** function key to return to the **SET-UP** menu.
9. Press Softkey 4 to exit back to the main Receiver menu.
10. Press Softkey 2 to receive records.
11. When records have been received, press the **OPTION MENU** function key to return to the main menu.
12. Press Softkey 3 to Analyze Records.

THE DIGIT RECEIVER/ANALYZER

FIGURE 4-1

4-2 THE MF/DTMF/DP RECEIVER/ANALYZER (OPTION 930A-01)

The Digit Receiver has 2 Menu Options which are installed in the Model 930A when **Option 930A-01: DP/MF/DTMF RECEIVER/ANALYZER** has been installed. These Menu Options appear under the **OPTION MENU** key as:

1) OPTION NUMBER: 4 **DIGIT RECEIVER**
2) OPTION NUMBER: 12 **WINK MARGINING**

The Digit Receiver Option can be used in **BRIDGE** mode on analog trunks, or the **MON-1/MON-1&2** modes on **PCM** trunks to monitor the interaction between equipment. In the **TERM** mode, the 930A can completely simulate terminating equipment. In either case the 930A will record the outpulsed digits it receives. In the **TERM** mode, the 930A will supply supervision. In the **BRIDGE,** or **MON-1/MON-1&2** modes, it will look for, and time, supervision events (Winks, Off Hooks, etc.). The 930A breaks an outpulsing sequence into groups of digits and supervision events. The digit groups, which can be **MF**, **DTMF**, or **DP** sequences, are called Records. The supervision events are divided into Winks, Delays, and Off-Hooks. The following paragraphs provide a detailed description of the use and operation of each of the two Menu Options which comprise the Digit Receiver Option.

The hardest part of using the Digit receiver is having to know what the calls "look like". This is where most people encounter difficulty when using the Digit Receiver.

The following paragraphs provide examples of the most common domestic calls so that you can learn the call set-ups. Once you have set the 930A to receive a particular type of call, you can then **store** the settings as a "program" in the 930A memory for future recall. This will help you avoid constantly re-entering receiver sequences.

4-2.1 HOW TO USE THE DIGIT RECEIVER (MENU OPTION 4)

This section begins with a explanation of the basic functions of the Digit Receiver. The examples give you more details about the test connections, trunk set-ups, and Call Sequence types. For those of you who just want to capture some digits, you can go directly to those examples, but the beginner is urged to read on.

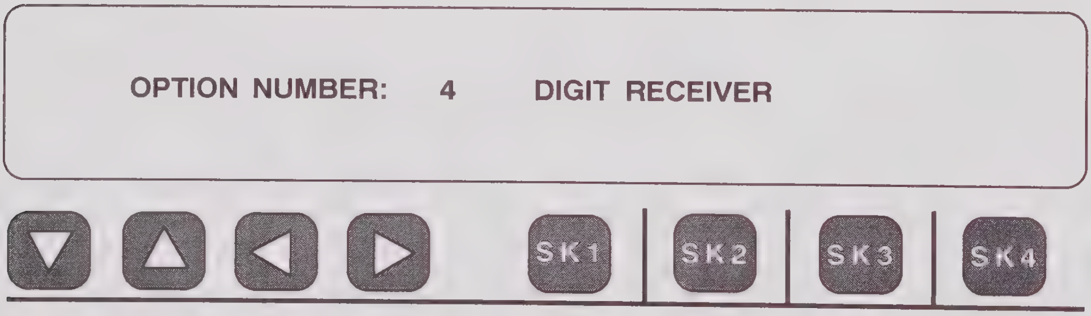
You have to set up Menu Option 4: DIGIT RECEIVER **before** you can receive calls, by performing the following steps:

Press the OPTION MENU ○ **Option Menu** function key.

Use the UP/DOWN ▽ △ arrow keys to

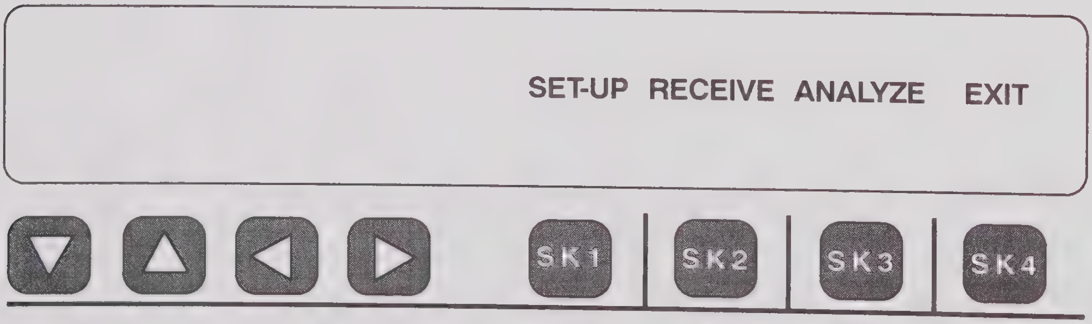
select Menu Option 04: DIGIT RECEIVER.

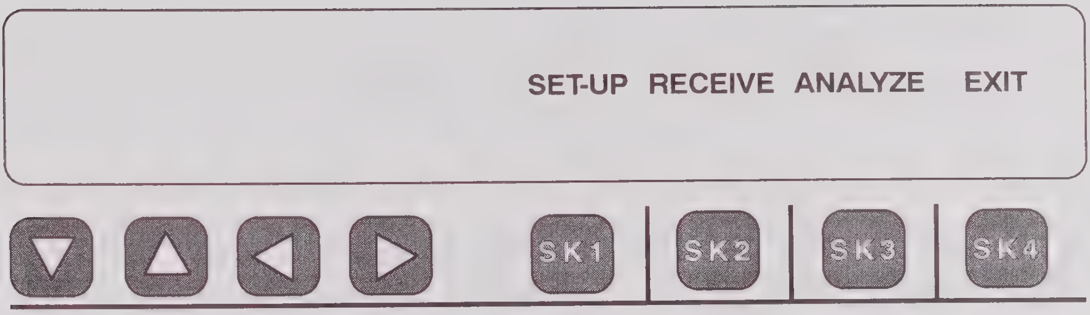
The 930A display is shown below:



OPTION NUMBER: 4 DIGIT RECEIVER

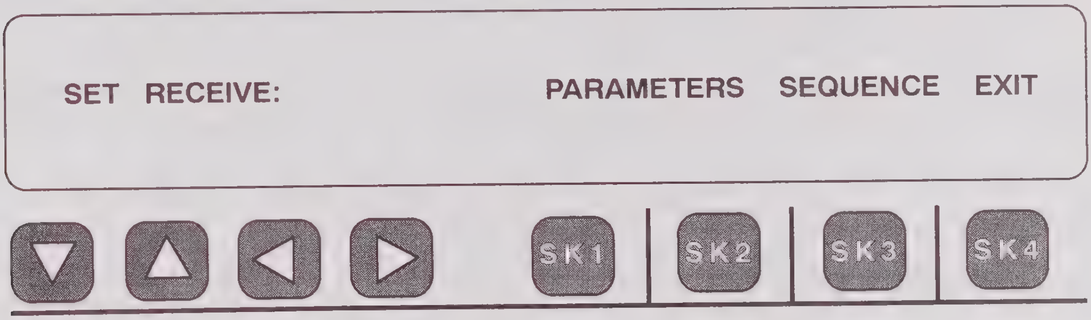
Press any softkey under the display to enter the menu. The main Digit Receiver menu is shown below:



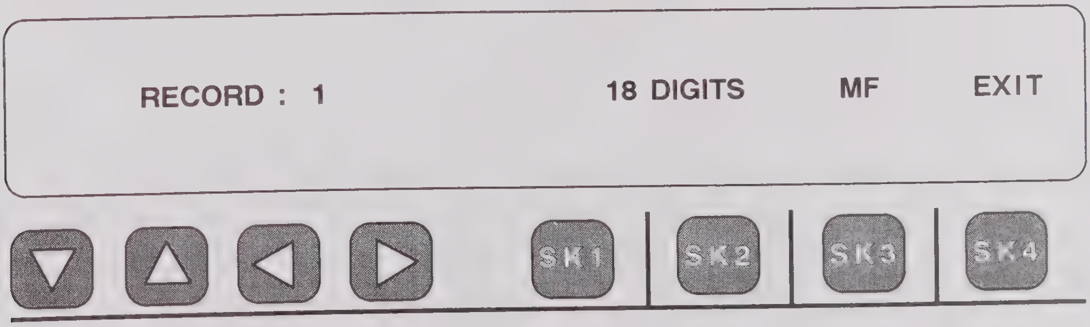


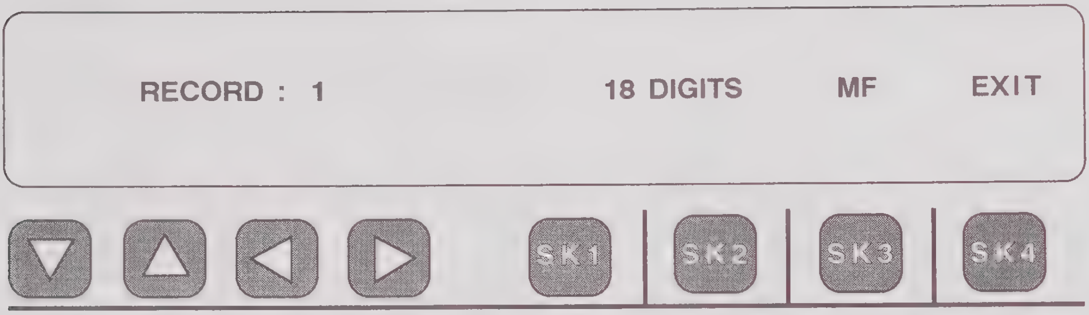
Unless you have previously set the 930A to receive calls on the particular trunk you are working on, it will be necessary to go through the **SET-UP** procedure.

Pressing Softkey 1 (under **SET-UP**) will enter the set-up menu for the Digit Receiver. This will require you to know something about the calls on your trunks. The display will show the following choices:



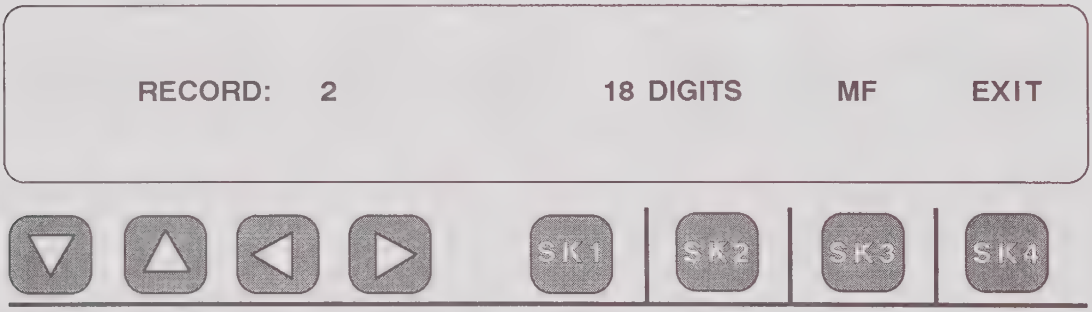
To set the PARAMETERS, you have to know whether the signaling on your Trunk is Multi-Frequency (**MF**), Touch-Tone (**DTMF**), or Dial Pulse (**DP**). If it is **DP** or **DTMF**, you will need to know how many digits long the call can be. This may sound like a lot, but in reality it is easy to figure out if you know where you are in the network. For the moment, just look at the 930A default display of **PARAMETERS** shown below:





RECORD : 1 18 DIGITS MF EXIT

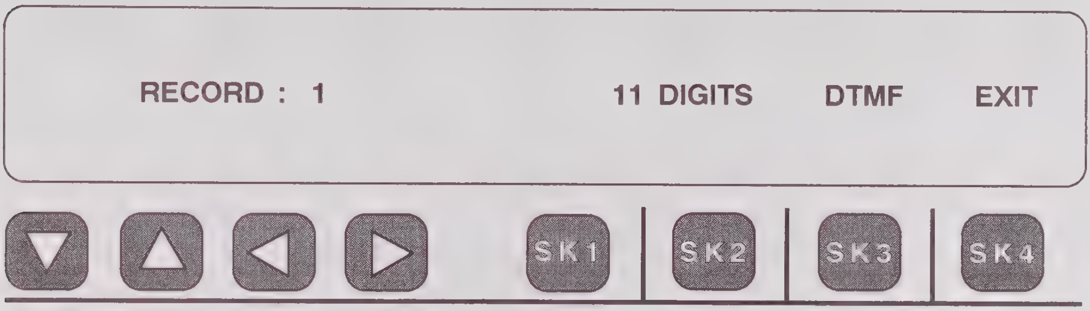
The "parameters" in this case are **MF** digits. The 930A treats each incoming call as a **RECORD**. Some types of domestic calls such as Feature Group D (Equal Access) may have as many as 3 Records in sequence going into an Access Tandem switch. If the call is in **MF**, you do not need to tell the 930A the length of each called number. This is because **MF** uses a Keypulse (**KP**) to begin a digit string and a Stop Pulse (**ST**) to end it, and they are unique. The 930A can tell where one **MF** string stops and the next one begins. For a Feature Group D call all you would need to do is use the **UP** Arrow key to make sure that Records 2 and 3 were also set to **MF** and 18 digits length. The set-up displays all look the same except for the number. For example, the display below shows the default for Record 2.



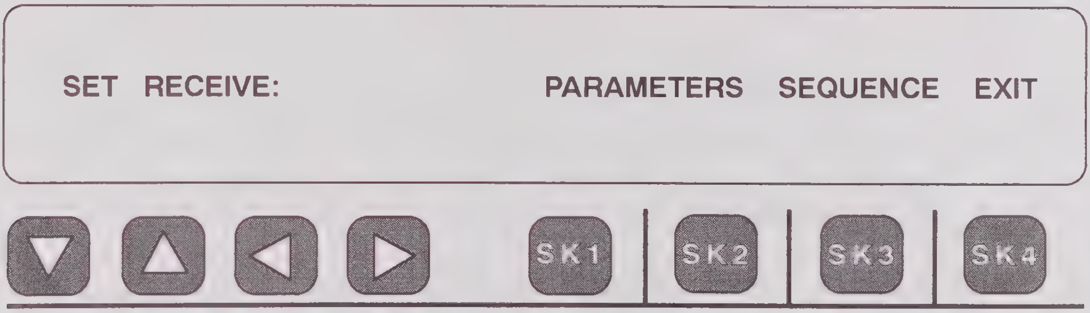
RECORD: 2 18 DIGITS MF EXIT

MF digit strings are usually found between telephone company switches since that is how they communicate to each other. Occasionally, you may find Dial Pulse coming from a Step-By-Step switch still in service, but this is getting rare as digital switches take over.

What do you do on an ordinary **POTS** (Plain Old Telephone Service) trunk? Again, if you think about it for a moment the answer will come to you. **First, you only** have 1 Record in most cases (unless it is a credit card call). You can only have Touch-Tone or Rotary Dial (**DTMF or DP**) from your home or office phone, and you must know which one you have. You can also figure out how long a digit string to expect. The worst case might be a long distance call on a Touch-Tone phone with area code plus a 1 to access your long distance carrier. This means a total of 11 digits of **DTMF**. An ordinary local call would be 7 digits long. Again, you just need to figure out where you are testing from and what type of calls are made there. Once you know what you want, press Softkey 3 to select the type of digits (for example, **DTMF**) and then enter the expected length of the string using the keypad. A sample display for an 11 digit long **DTMF** Record is shown below:



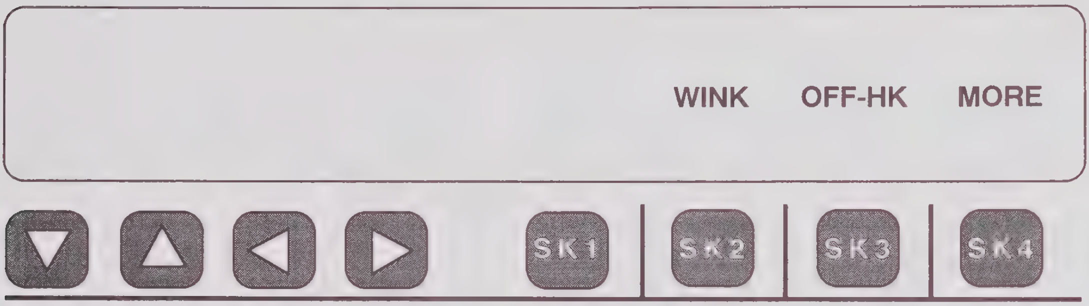
Once you have set the **PARAMETERS** for the type of call you want to receive, press Softkey 4 (under **EXIT**) to return to the **SET-UP** menu.



Now comes the hard part; you need to know what the **SEQUENCE** is in order to get the 930A to do anything. **It is not really difficult** to figure out. The key again is to think about what service you have and where you are in the network. If all else fails, you can find the information in such useful references as the "LSSGR" published by Bellcore, or the Switch manufacturer's manuals.

There are only 2 basic types of call sequences; Wink Start and Immediate Dial. Everything, including Feature Group D, is just an offshoot of one or the other of these 2 types.

To set the SEQUENCE you press Softkey 3 under **SEQUENCE** in the set-up menu on the previous page. The 930A default display is shown below:

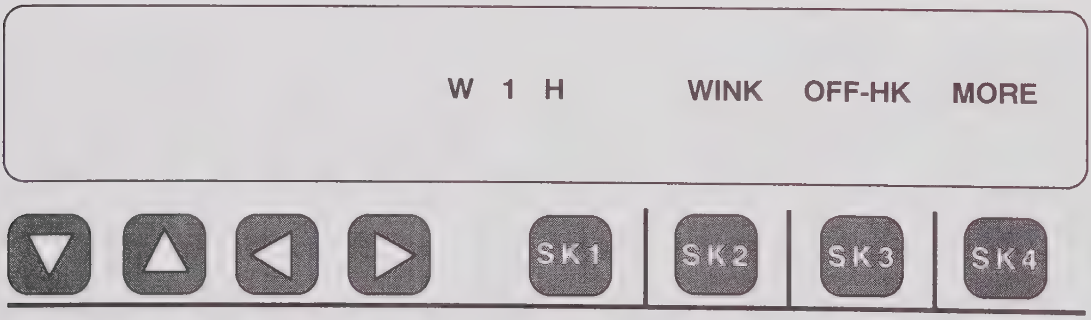


If you had a previous sequence in your 930A then that would have been displayed. Unless the previous sequence just happens to be what you want, you should press the **CLR** key to start fresh. **The 930A will not** let you enter the **RECEIVE** mode until you have entered a **SEQUENCE**.

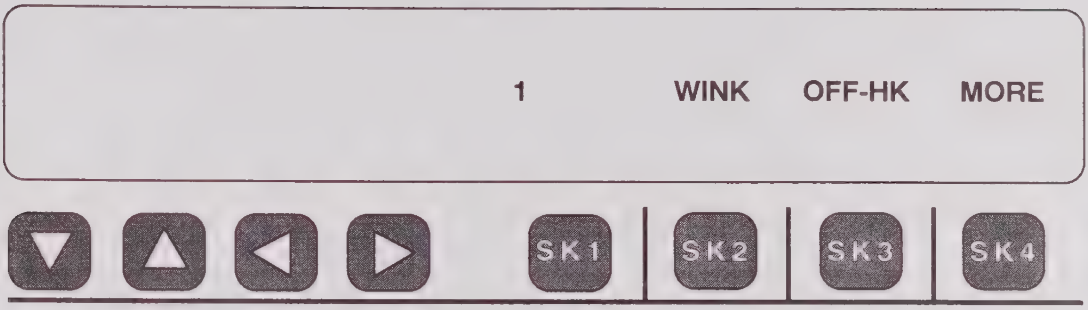
The question now is, "What do I put in for a sequence?" This is where you need to know about the type of call and the trunk it is on. If you are testing on an inter-office trunk between electronic switches, you have a very good chance of being on a T-1 span first, and on a **Wink Start** trunk second. You also will be seeing **MF** digits in all probability. If you are on a simple Loop Start **POTS** line, it is an **Immediate Dial** trunk. If you are testing a **PBX** with Ground Start trunks, the circuit has to be completed before digits can be sent. This means you have to send an Off-Hook first on a Ground Start.

What do these sequences look like when entered into the 930A display?

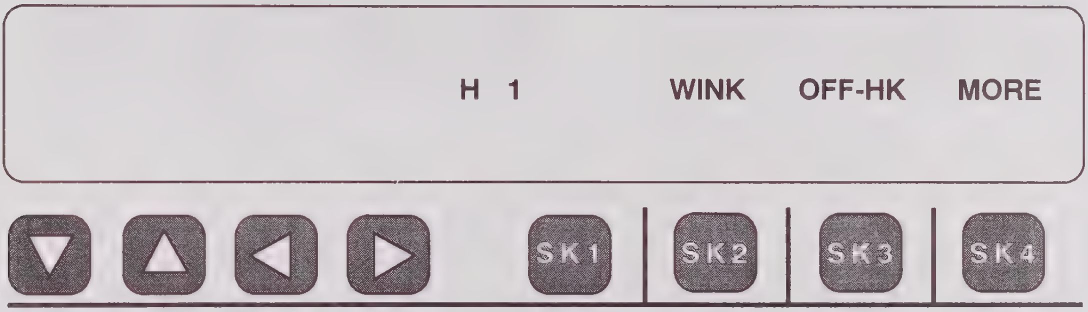
WINK START (See Example in Section 4-2.4)



IMMEDIATE DIAL (See Example in Section 4-2.2)



IMMEDIATE DIAL ON GROUND START (See Example in Section 4-2.3)

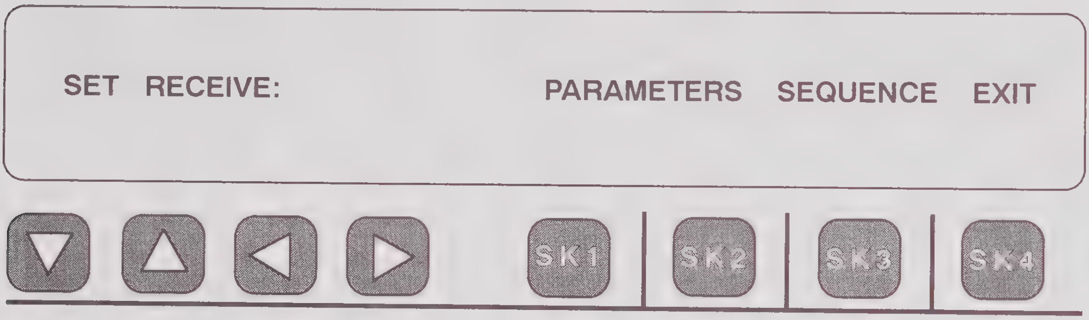


How did we generate these displays? **Easy**. All that was done for the **Wink Start** Trunk was to press Softkey 2 (under **WINK**) and the **W** appeared. This tells the 930A to give the far end a **Wink** when it sees the Trunk being seized. Then the number **1** was entered to tell the 930A to receive a single "Record" (since this was a regular domestic call example) from the far-end. Last but not least, an **OFF-HOOK** was entered so that answer supervision could be returned and timed. This was done by pressing Softkey 3 under **OFF-HK** and an **H** appeared after the **W 1**.

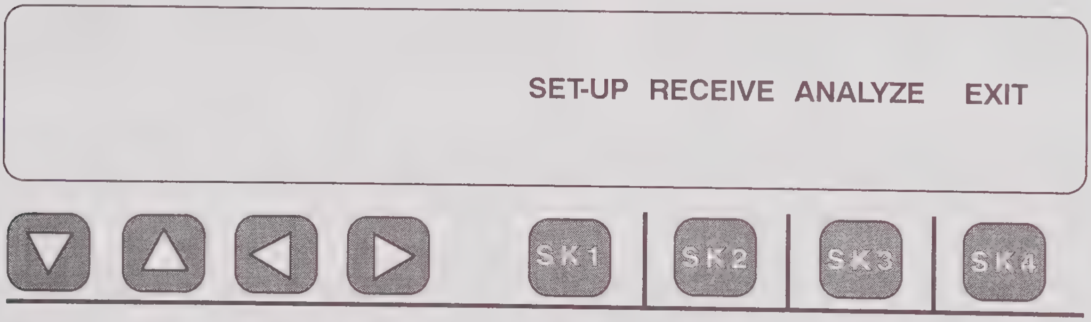
For the **IMMEDIATE DIAL** Trunk, it is even easier. You tell the 930A that a Record is coming right after the Trunk is seized. There are no winks involved. You enter a **1** from the keypad and press **ENTER**. This is shown in the display above. You could leave it at this just to capture digits, but it is a good idea to send back an **OFF-HOOK** when you terminate a Trunk. So enter an **H**, after the **1**, by pressing Softkey 3 (under **OFF-HK**) and the display will read **1 H** instead of just **1**.

On a Ground Start Trunk, you must start with an **Off-Hook**, so here you enter the **H** first and then the **1**. The sequence would be **H 1** in this case. **Do not be afraid to make a mistake** because you can always press the **CLR** key and start again.

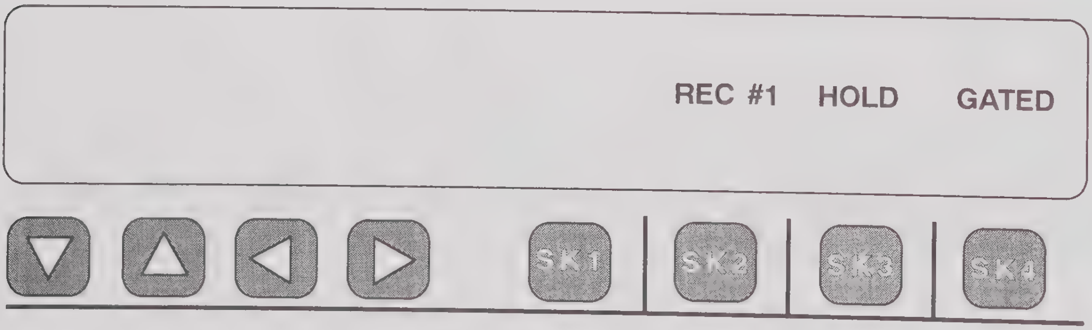
After you have entered the sequence into the 930A, press the **OPTION MENU** key and you will see the main **SET-UP** display return:



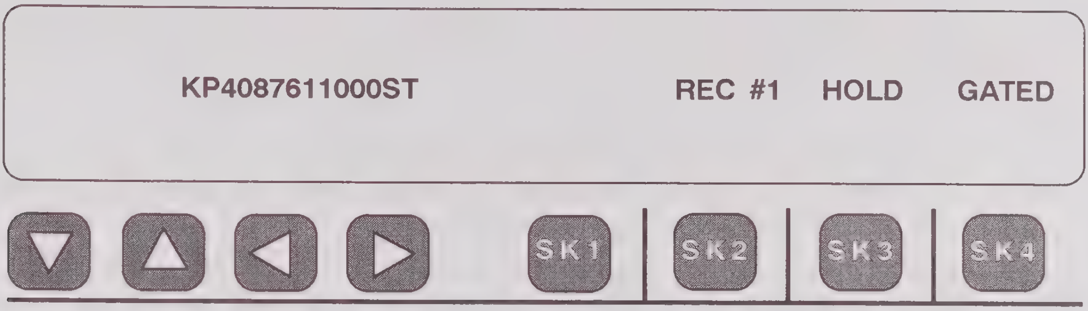
Now, press Softkey 4 (under **EXIT**) and the 930A display will back out another step to the main selection menu:



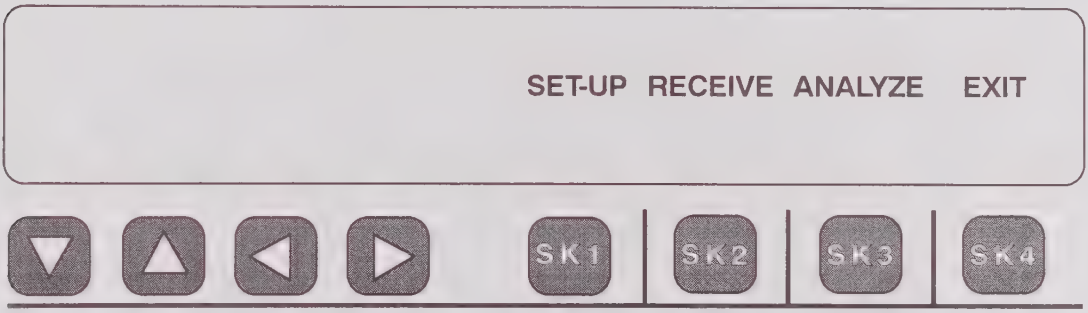
To receive digits, press Softkey 2 (under **RECEIVE**) to activate the digit receiver.



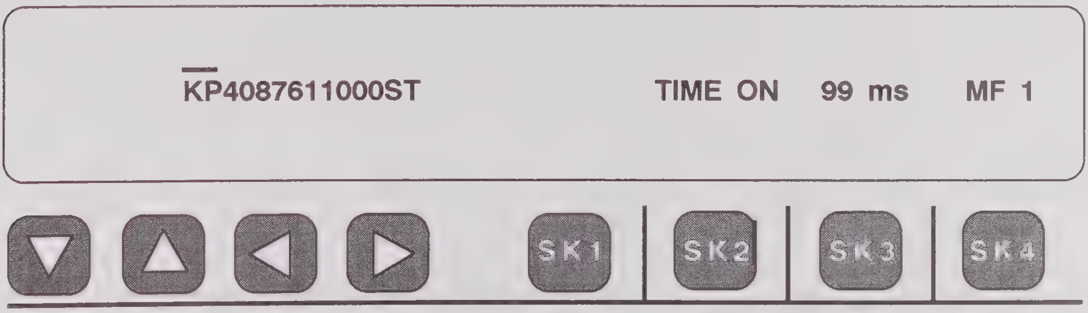
The next time the trunk is seized, and digits are sent, you should see them come across the 930A display. An example might look like:



Once the digits have been received, you can press the **OPTION MENU** key to back out of the Receiver to the main display.



At this point, press Softkey 3 (under **ANALYZE**) to review the characteristics of each digit in the string you received. A sample display appears below:



In the above example, an **MF** "Record" has been received. The cursor starts out over the first digit. In this case it is the **KP**. By pressing Softkey 2, you can page through the levels and frequencies of the two tones which make up the **KP** as well as their **On** and **Off** times. You can then use the right arrow key to move the cursor to the next digit, and so on.

If you had set the 930A to receive a Multi-Wink call such as a Feature Group D sequence, then the 2 or more "Records" would be stored in the Analyzer. You would be able to look at them by pressing Softkey 4 (under **MF 1**) in the example display on the previous page. This acts like a "wheel" and pages you through Records 1 to 4 and then back to 1 again.

When you are through, press the **OPTION MENU** key to back out of the Analyzer display. From the main menu, you can exit entirely from this Option, or go back into the Receiver to collect more digits.

If you have a Printer connected to the 930A, then the 930A will automatically go on receiving digits, and print the Digit Analysis with a Time/Date stamp on the printout. Wink Timing results from Menu Option 9 will also be printed if you are testing on a 4-wire analog trunk or a T-1 span (Option 930A-09E).

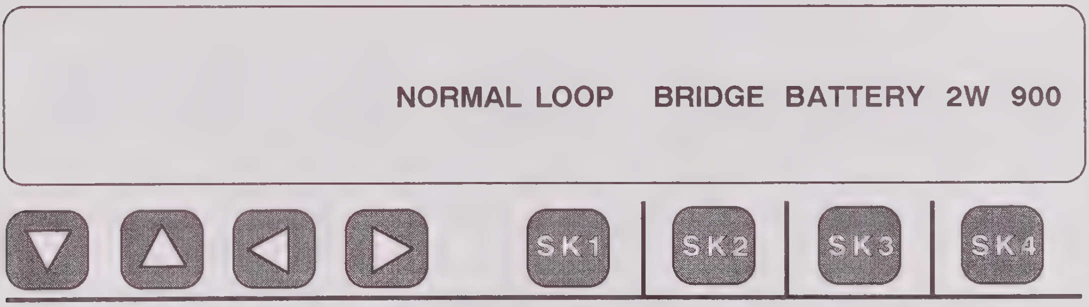
The examples which follow are intended to show you some of the basic types of calls a 930A can receive and analyze. The procedures for setting up the Digit Receiver are the same for all types. Once you know what type of digits to expect, and what the call sequence looks like, you can set the 930A accordingly. The Digit Receiver gives you so much flexibility that at times it may seem overwhelming. Once you get it set up, you can reduce all the flexibility to a few keystrokes by storing the Digit Receiver menu as a program using the **STO** key. Then all you have to do is **RECALL** that memory location (00 to 39) to bring back the Digit Receiver with your particular settings. In fact, you may want to store some of the example set-ups which follow. **The DIGIT RECEIVER is independent of the TRUNK TYPE you have selected.** This means that if you set-up the Digit Receiver to work on a Feature Group D call on a T-1 PCM Trunk, it will retain its settings, even if you switch to an E&M Type I Trunk. This saves you having to re-enter the settings once you have input them.

4-2.2 HOW TO RECEIVE CALLS ON PBX OR POTS TRUNKS

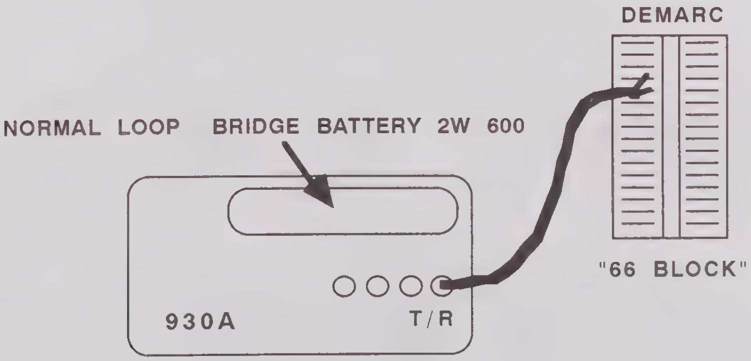
The first step when using the 930A for any measurement is to set up the **TRUNK TYPE**. PBX trunks as well as **POTS** trunks are generally 2-wire lines from the phone. Their impedance may be 600 ohms at the **DEMARC** but is usually about 900 ohms at the phone. They are either Loop Start (the most common Trunk Type) or Ground Start (at some PBX's). Examples of both are given in this section.

For the example of a LOOP START trunk, assume that we only want to Bridge onto the line, and not interrupt service. Details of Trunk Type selection and set-up are contained in Section 3-4.

To monitor a call on a POTS line, set the 930A **TRUNK TYPE** so that its display matches the one below:



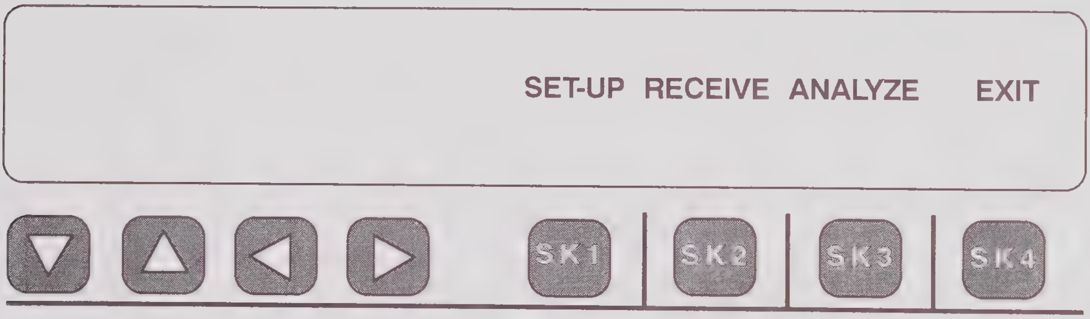
Now connect the **T/R** jack of the 930A to the Trunk access point. This is typically at the "66 Block," or **DEMARC** point. You would use a 310 to alligator clip test cord and clip onto the Trunk without pulling the Bridging clips from the **DEMARC**. The diagram below shows the connection:



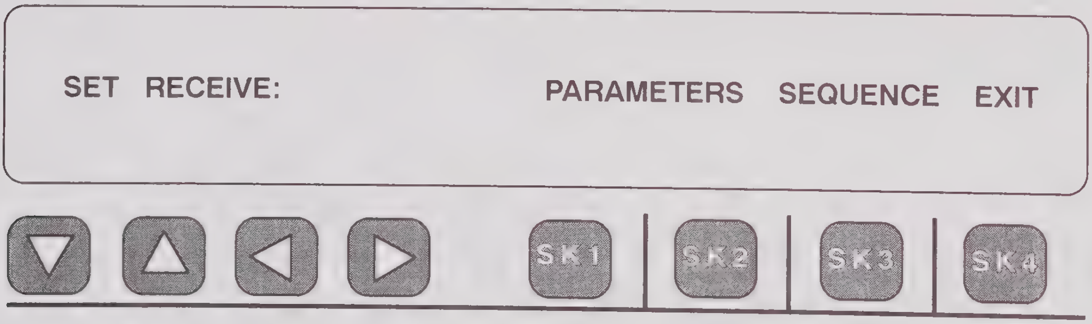
Before going to the **DIGIT RECEIVER** (Menu Option 4), check the front panel Supervision LED's. They should match the status of the Trunk. That is, they should show **ON HOOK** on both **ORIG** and **TERM** if the trunk is idle. When the subscriber end goes **OFF HOOK** to dial the call, the **ORIG** LED should show **OFF HOOK**. When the call completes, the **TERM** LED should go **OFF HOOK.**

If these states are reversed then you need to set the TRUNK TYPE to REVERSE LOOP instead. The other settings remain the same.

Now you can press the **OPTION MENU** key and go to Menu Option 4: **DIGIT RECEIVER.** Press any softkey under the display to get to the main menu:

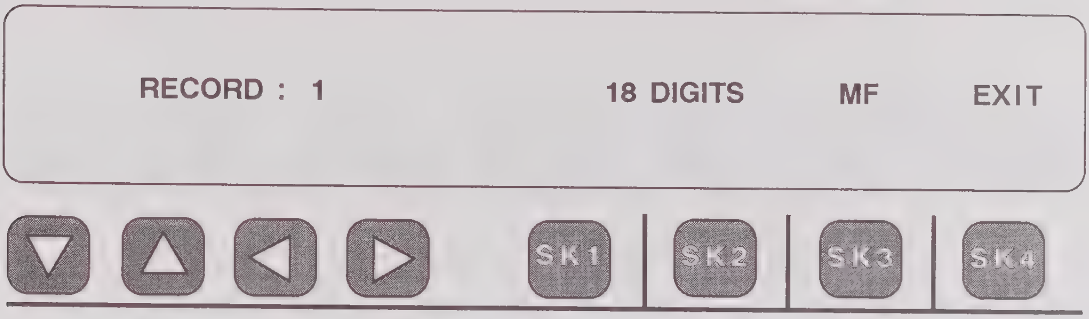


Next, you press Softkey 1 to set up the 930A. On a **POTS** line, you can only have Dial Pulse or Touch-Tone. The set-up procedure is the same for either one. We want to look at the digits being dialed, so normally, we have control over what is being sent. **For this part of the example**, Touch-Tone digits are assumed.



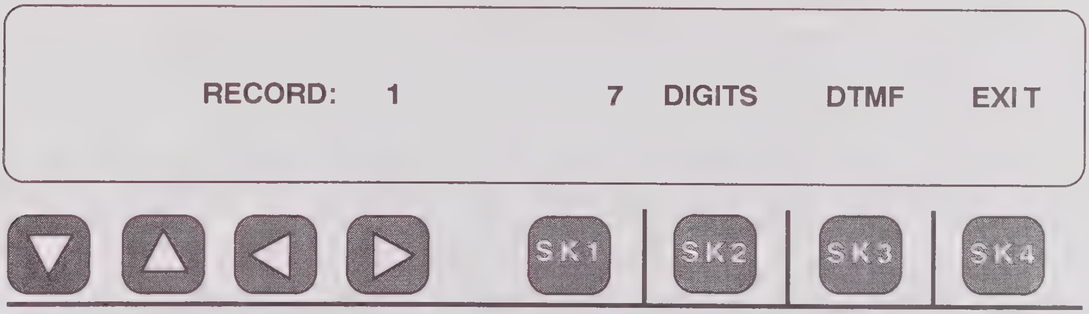
To select Touch-Tone digits, press Softkey 1 or 2 to get to the **PARAMETERS**. This brings up whatever the last selection happened to be. We can start from the default display of **PARAMETERS**.

The default parameter settings for the 930A has all 4 Records set to **MF**. So we have to change the default display for Record 1 shown below:

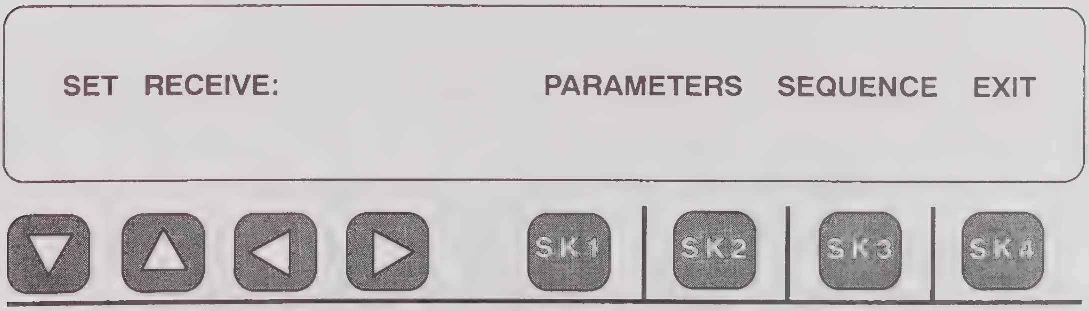


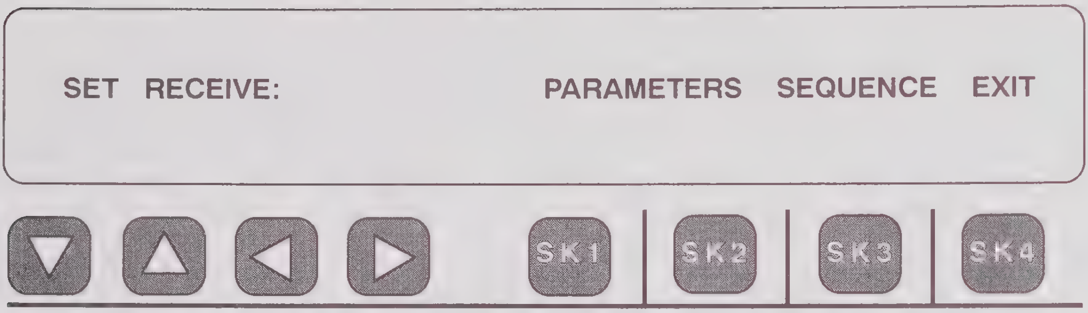
There will be only 1 Record for this type of call, so you only have to deal with the Record 1 display. You will have to press Softkey 3 to change from **MF** to **DTMF**. Then you should enter in the expected length of the called number using the keypad. Just for example purposes, let's make it a local call, 7 digits long.

After you have correctly entered the length, the display will be:

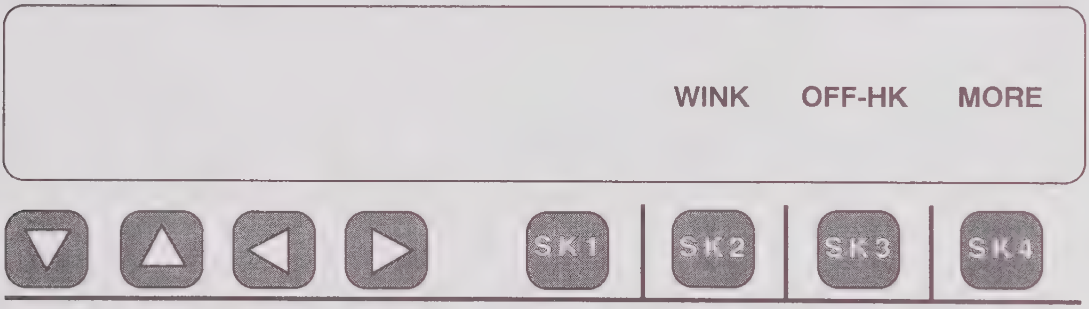


Now that you have set the parameters, the **SEQUENCE** is next. Press Softkey 4 (under **EXIT**) and the selection display returns:

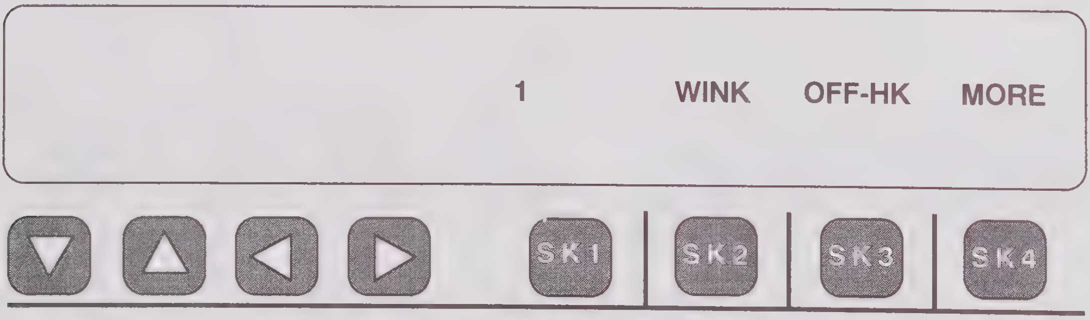




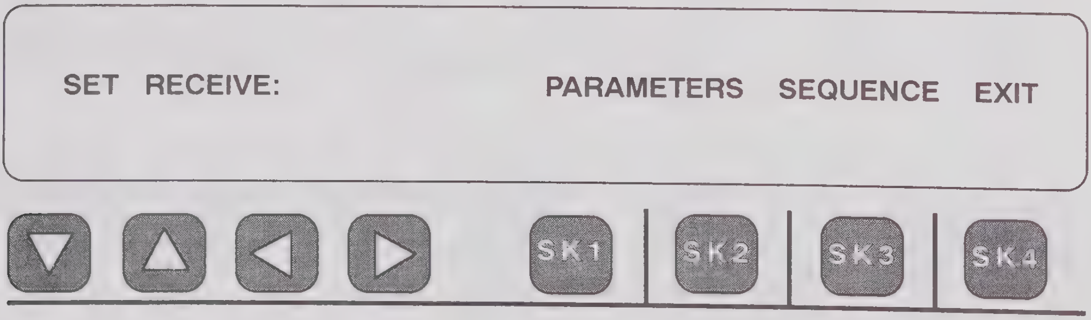
Press Softkey 3 (under SEQUENCE) and the display will change to:

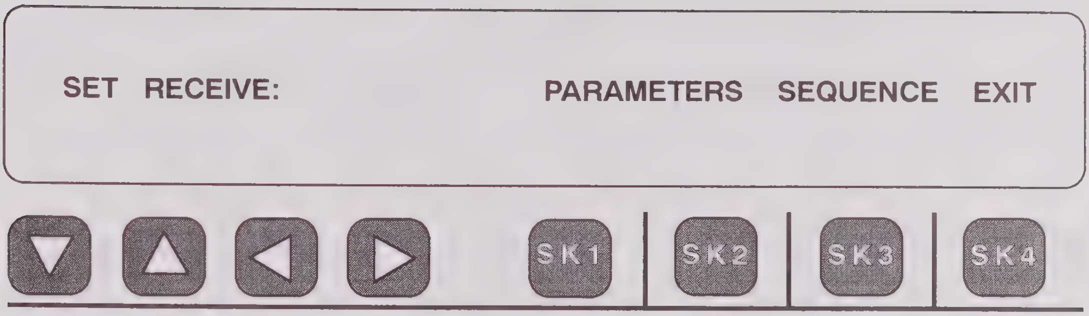


If a previously entered sequence is showing, press the **CLR** key. **Enter a 1** from the keypad and press **ENTER**. The display now looks like:

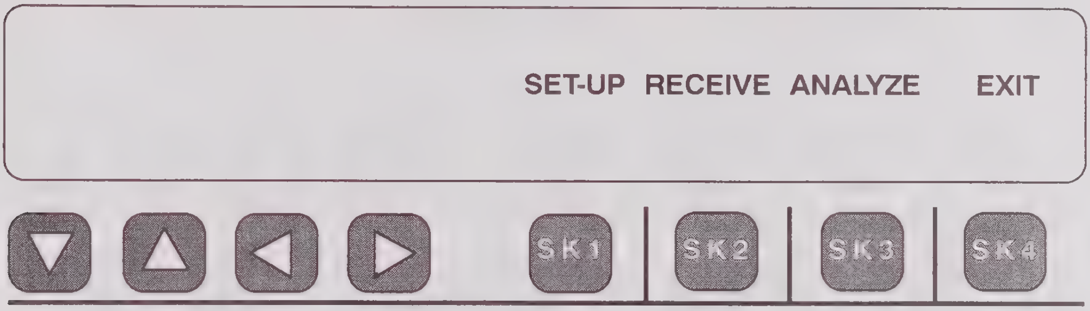


Next, press the **OPTION MENU** key to back out of this display into:

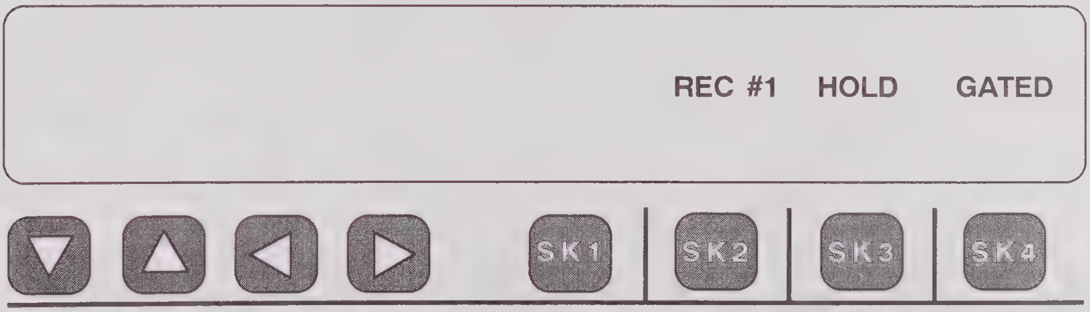




Press Softkey 4 to exit back to the main menu:

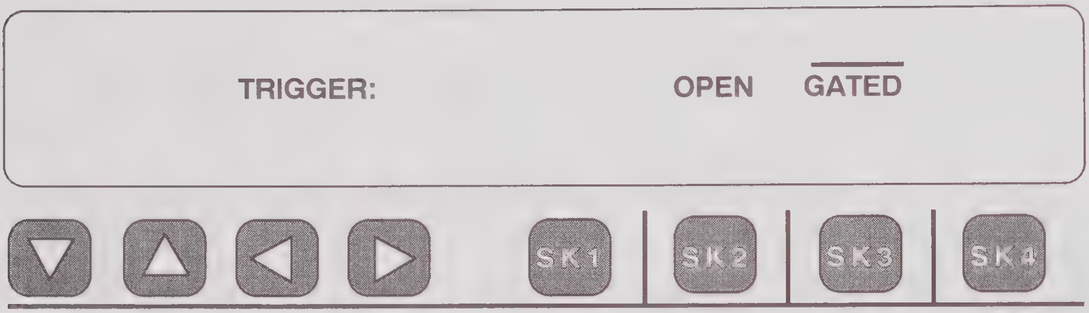


To receive the call and see the digits, press Softkey 2 (under **RECEIVE**) and the display should become:

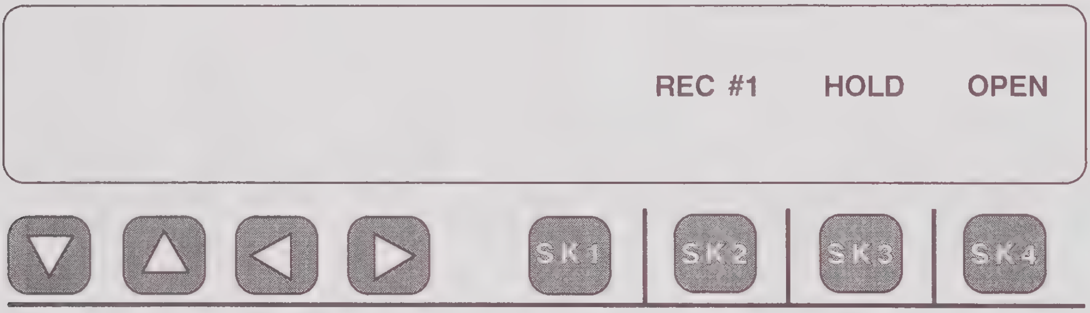


The 930A is waiting for the Trunk to be seized and digits dialed. When this happens, you should see them come across the display. Sometimes, it is necessary to disable the 930A supervision detection to get the digits.

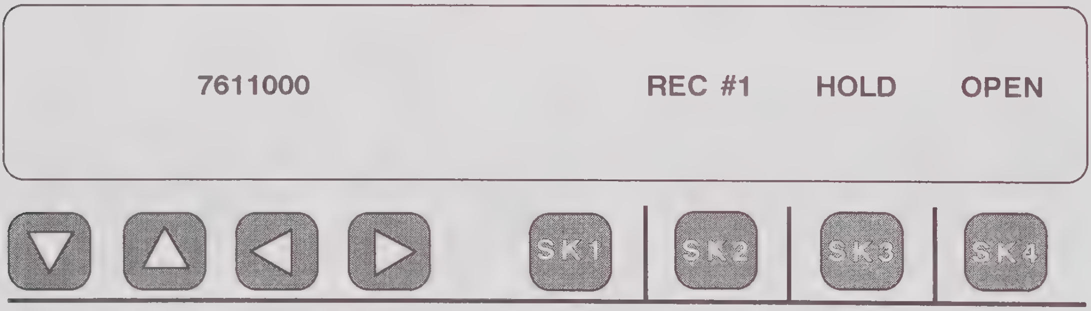
To ignore supervision, press Softkey 4 (under **GATED**) and the **TRIGGER** display, shown on the following page, will be presented.



Press Softkey 2 (under **OPEN**) to select the **OPEN** mode. The display will become:



One way or the other, you will see digits come across the display when they are dialed. In the **OPEN** mode, the display might look like:

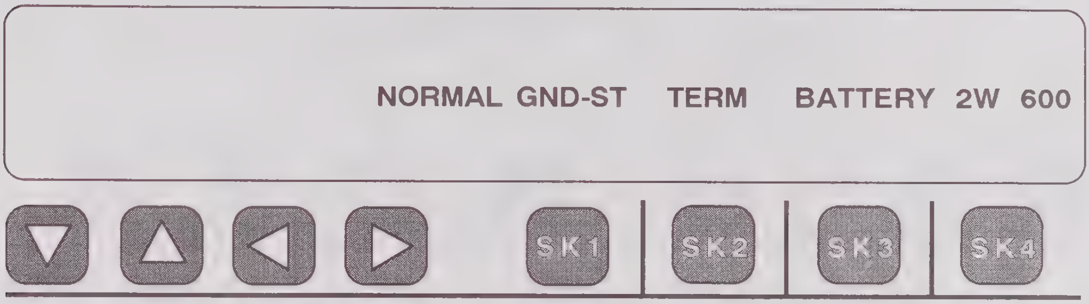


When receiving digits in the **OPEN** mode, you will have to ignore some of the "Errors" which will be displayed. **OPEN** is just what it says. This mode will make transients, speech and other things show up as "**E's**" before, in between and after, the digits you are capturing. In most cases you can ignore them and just look at the digits.

4-2.3 RECEIVING CALLS ON PBX GROUND START TRUNKS

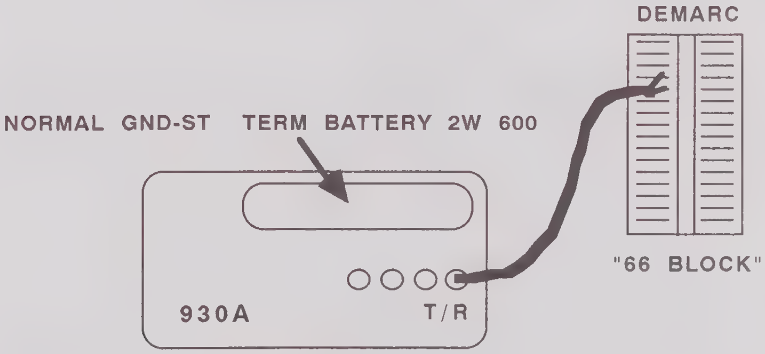
For the GROUND START example we will show the 930A Terminating the Trunk. Remember that we could as easily follow the previous example to set the 930A Ground Start Trunk Type to Bridge mode.

Select the **NORMAL GND-ST** Trunk Type on the 930A and use the softkeys to change whatever appears on the display until it matches:



NORMAL GND-ST TERM BATTERY 2W 600

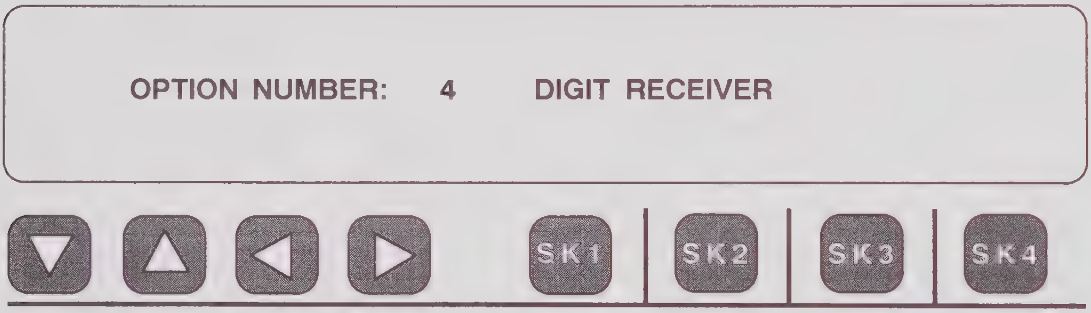
Again, this is a 2-wire trunk so the test cord connection at the **DEMARC** is the same as before **except** that now the Bridging clips have been pulled. This isolates the subscriber from the Central Office. From this point, the 930A can simulate either end to the other. For this example, the 930A will "look" toward the subscriber, simulate the Central Office, and supply Battery. The 310 to alligator clip test cord connection and 930A Trunk Type set-up is shown below:



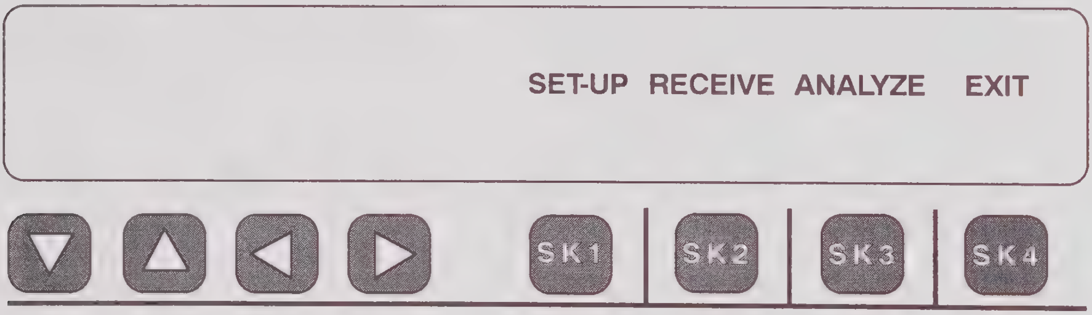
The choice of 600 ohm impedance is a guess. It is either 600 or 900 ohms, and if the **DEMARC** point is not too far from the subscriber telephone set, then it is a good guess. Since we are only looking at digits, the choice does not really matter. It would matter more if we were analyzing the digits.

Once the test cord has been connected, check the front panel supervision LED's to make sure they both show **ON-HOOK** when the subscriber phone is **ON-HOOK**. If not, you may have to change the Trunk Type to **REVERSE GND-ST** to get the supervision correct.

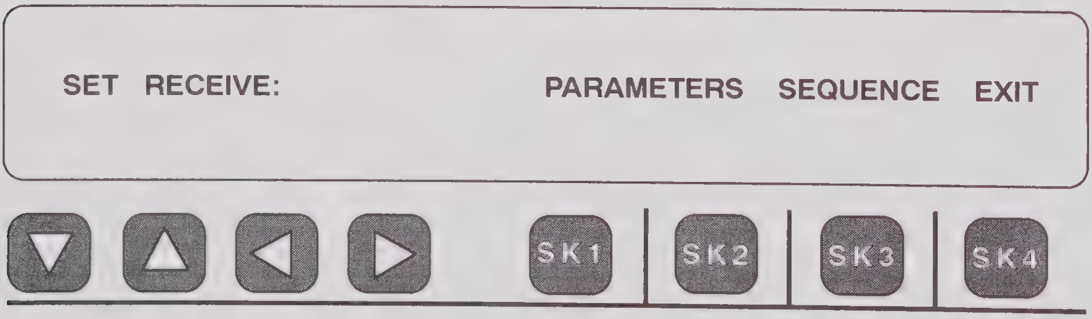
Now you can press the **OPTION MENU** key and go to Menu Option 4: **DIGIT RECEIVER**.

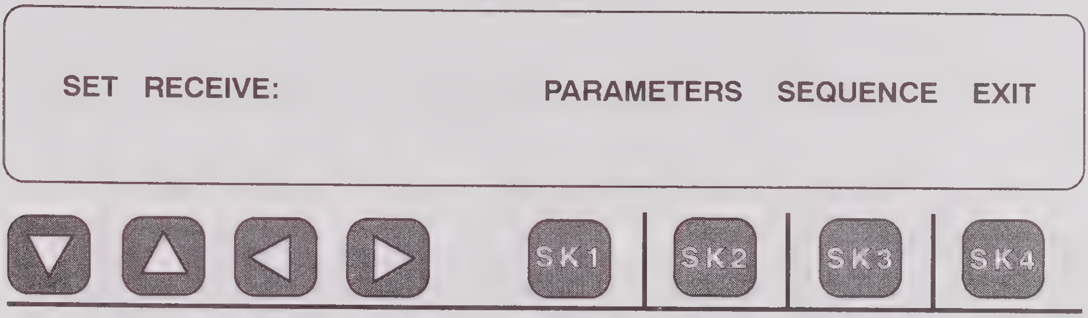

OPTION NUMBER: 4 DIGIT RECEIVER

Press any softkey under the display and you get inside to the main menu:

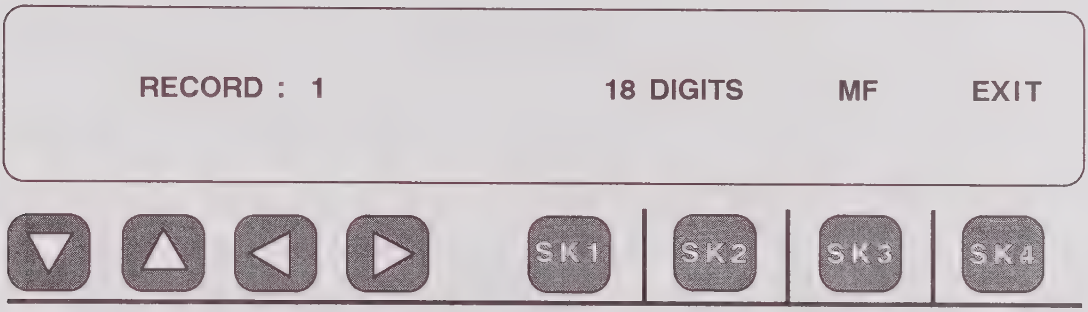


Again, you have to get into the **SET-UP** menu first unless you have already set the 930A previously. **For this example**, assume that we want to capture some digits from a Dial Pulse or Rotary phone. For simplicity we can also specify it to be a 7 digit long number. After pressing **SET-UP:**

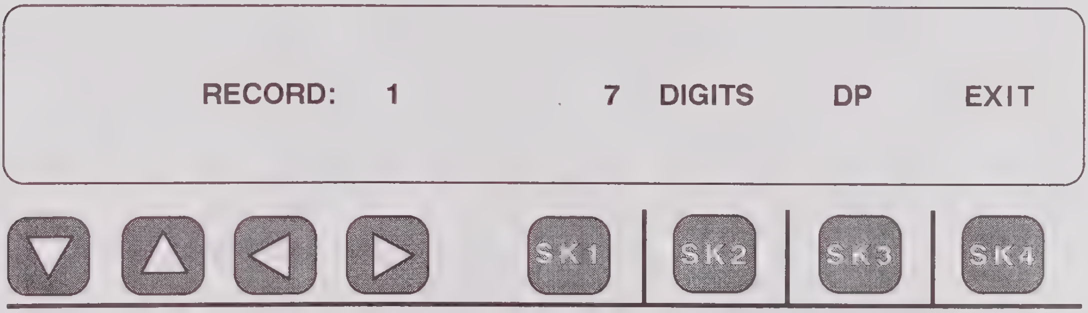



SET RECEIVE: PARAMETERS SEQUENCE EXIT

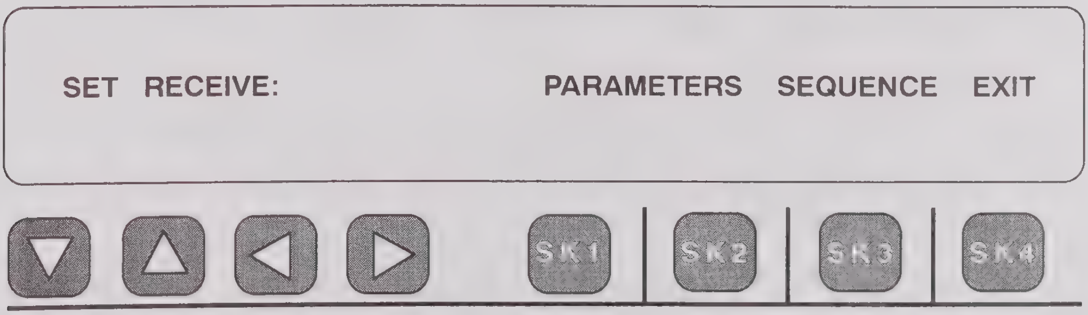
Press Softkey 1 or 2 (under **PARAMETERS**) to get to the menu below:

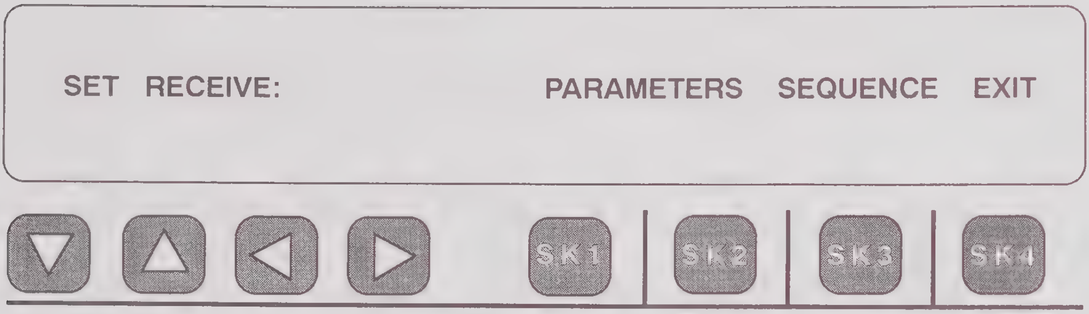

RECORD : 1 18 DIGITS MF EXIT

To enter 7 digits of Dial Pulse, press 7 on the keypad and then **ENTER**. Press Softkey 3 until **DP** appears and the display looks like:

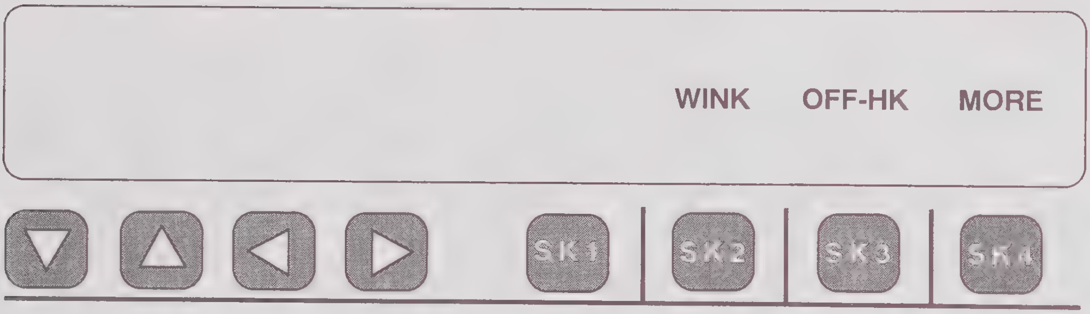

RECORD: 1 7 DIGITS DP EXIT

Now press Softkey 4 to exit back to the **SET-UP** menu:

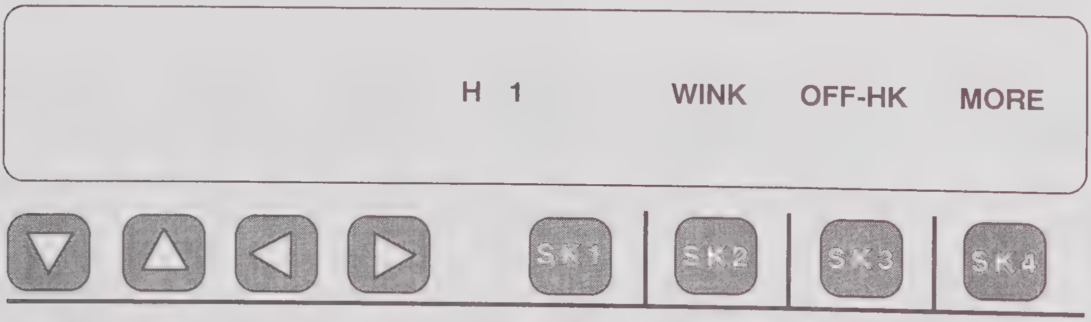

SET RECEIVE: PARAMETERS SEQUENCE EXIT



To enter the SEQUENCE, press Softkey 3 to get the display:

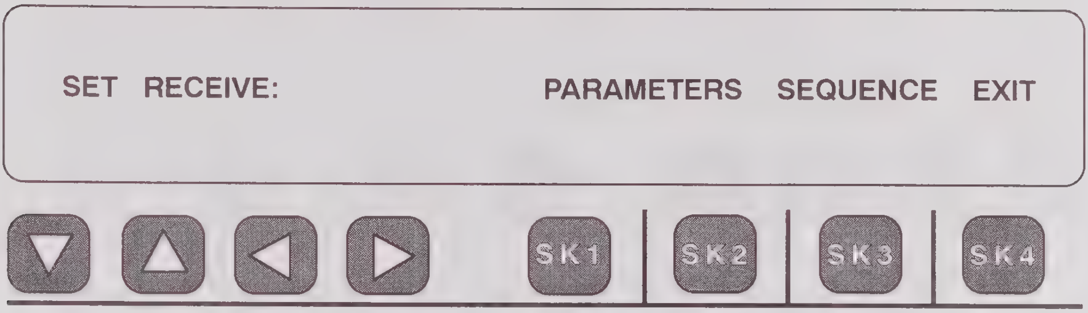


If there is a sequence displayed from a previous setting, press the **CLR** key. **Now you can enter** the sequence for a Ground Start Trunk. **Remember** that this type of Trunk has to "see" an **OFF-HOOK** first. Press Softkey 3 (under **OFF-HK**) and enter the number **1** from the keypad. The display will look like the one below when you have entered the sequence correctly:

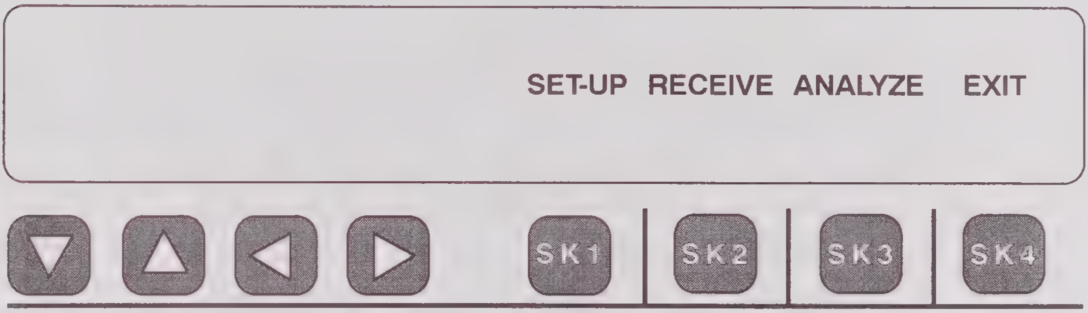


Press the **OPTION MENU** key to back out of this menu (there is no need to enter another Off-Hook at the end to just capture digits).

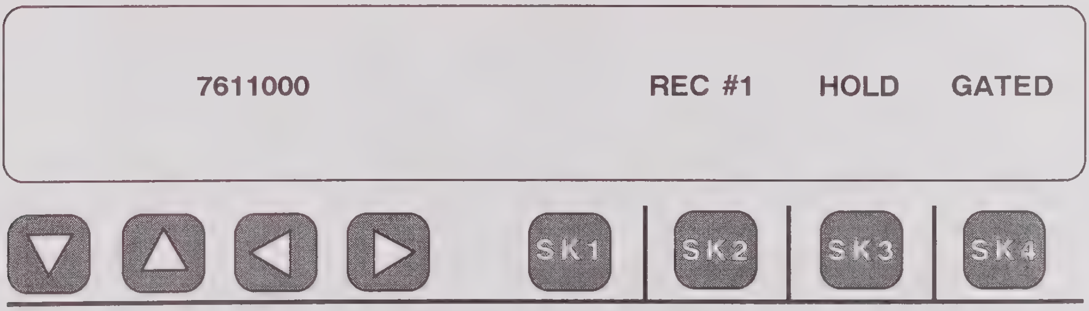
The SET-UP menu reappears:



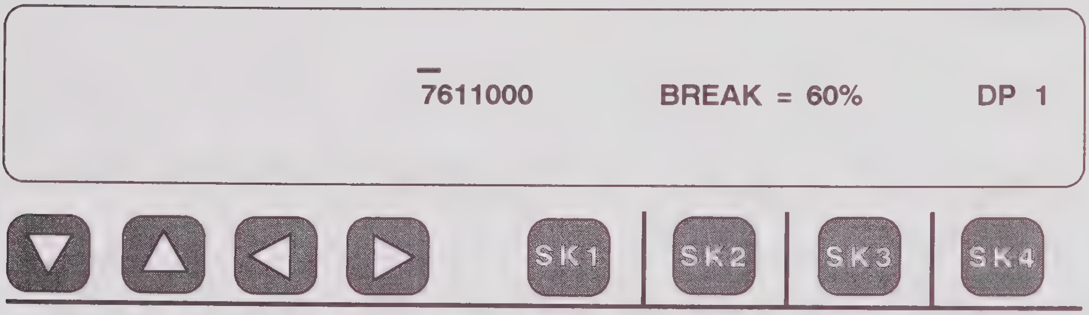
Press Softkey 4 to exit back to the main menu:



Press Softkey 2 (under **RECEIVE**) and the 930A will wait for the Trunk to be seized and digits will be captured.



Once the digits are "captured," you can press the **OPTION MENU** key to back out of the receiver, and then select **ANALYZE** to check the digits.



```
7611000        BREAK = 60%        DP 1
```

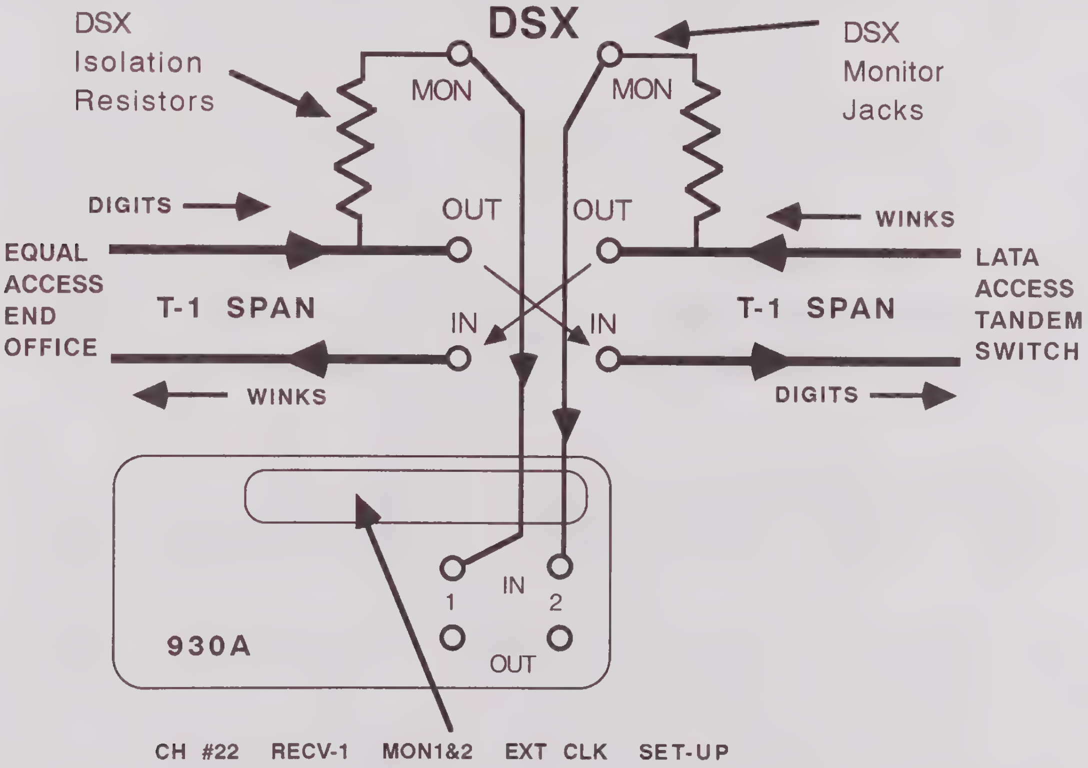
You can check the %Break, Pulse Rate and Interdigit Timing of the Dial Pulse digits in the same manner described for the **DTMF** digits of the previous example. **If you have the 930A** connected to a **PRINTER**, the analysis will be printed out automatically.

You could just as easily have received Touch-Tone digits by selecting **DTMF** under the **PARAMETERS** Set-Up instead of **DP**. The **SEQUENCE** would remain the same for a Ground Start Trunk. You could Bridge onto the line instead of Terminating it by going to **BRIDGE** in the **TRUNK TYPE** display. Once you learn the basic operation, it is easy for you to make alterations.

4-2.4 RECEIVING AN EQUAL ACCESS CALL SEQUENCE ON A T-1 PCM CHANNEL

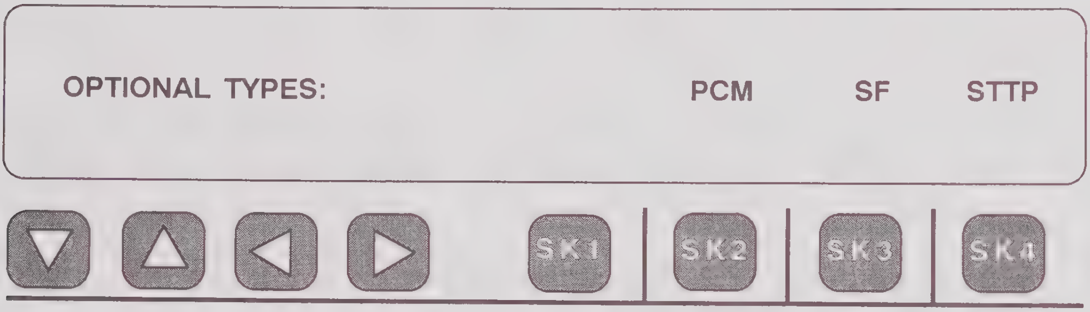
To begin, your 930A must be equipped with Option 930A-09E, in addition to Option 930A-01, for this example to be useful.

The first step is to set up the **PCM Trunk Type** on the 930A and connect it to the T-1 span at the DSX Monitor jacks (the Monitor jacks at a T-1 CSU or a T-1 Office Repeater will work also). Normally, you monitor both directions on a T-1, so that is how this example will proceed. The test cords are connected from the 930A's **PCM INPUTS 1&2** to the **DSX Monitor jacks** as outlined in Section 6-3 and shown below:

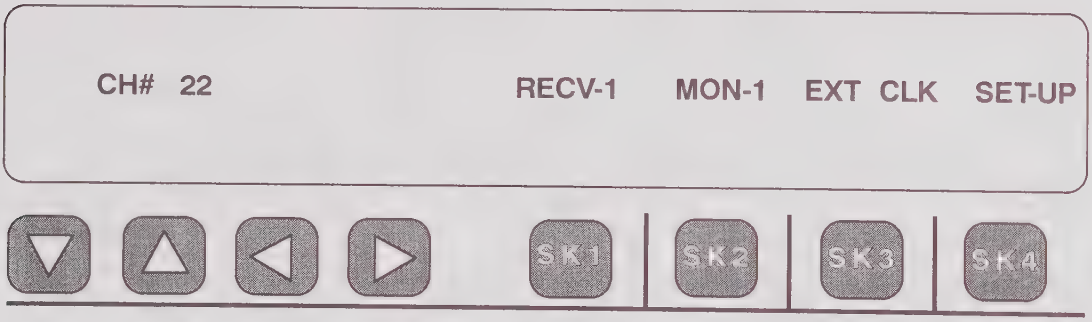


This diagram shows a Feature Group D call coming from the End Office into the Access Tandem with the 930A connected between the offices. **PCM IN 1** (the **RECV-1** side) is connected to the side the digits are coming from at the Monitor jack of the **DSX**. **PCM IN 2** is connected to the **DSX Monitor jack** from the Access Tandem switch. The Winks come from the Access Tandem. The 930A is set to monitor both directions.

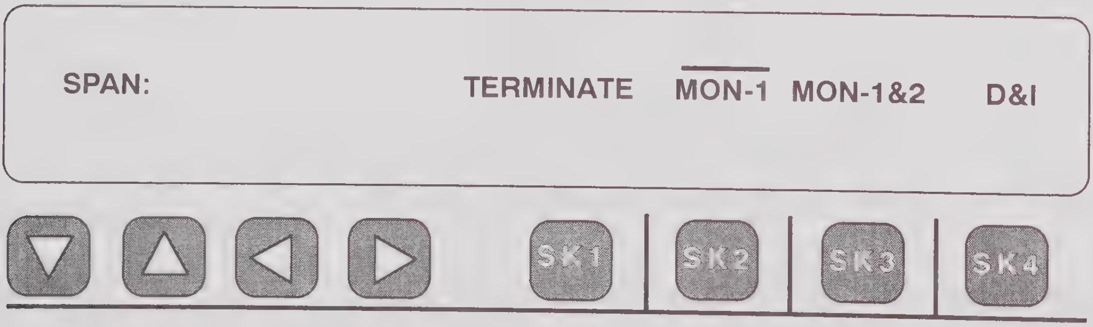
Press the TRUNK TYPE function key and then press Softkey 1, or use the **UP/DOWN** Arrow keys, to get to the display below:



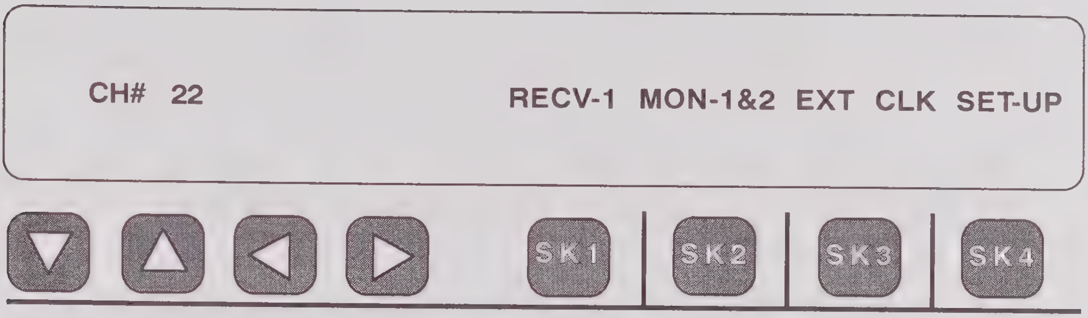
Press Softkey 2 (under **PCM**) to bring up the main **PCM** display. The default display is:



To monitor both directions of transmission, press Softkey 2 (under **MON-1**) and the Mode Selection display will appear:

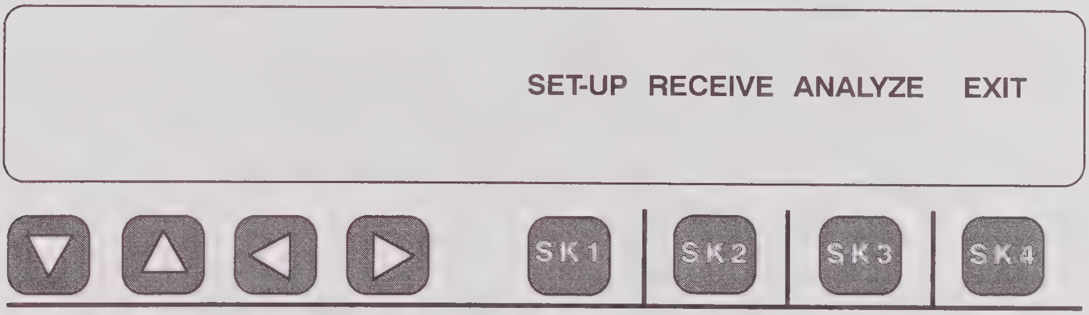


Choose MON-1&2 by pressing Softkey 3 and both of the 930A's **PCM** receivers will be activated. The display will change to the one on the following page.



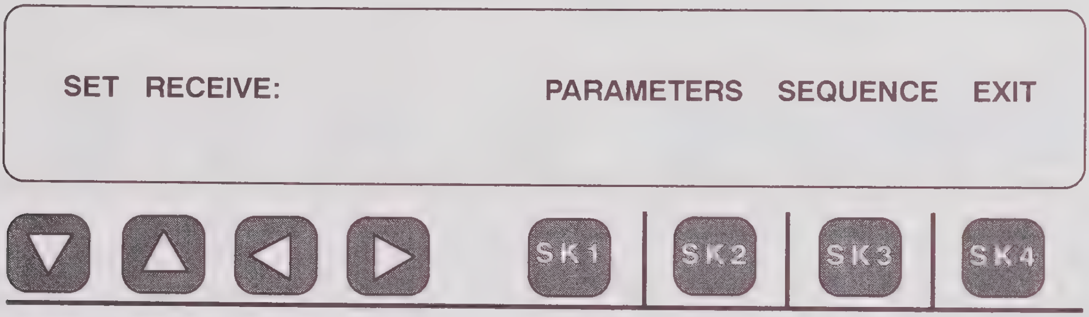
You can choose any channel you want from the keypad. You can change direction from **RECV-1** to **RECV-2** and back by pressing Softkey 1. Softkey 3 is purposely not active to make sure you are Loop-Timed in this mode. The **PCM SET-UP** under Softkey 4 should be left at the factory default settings, unless you know you need to change them. Refer to Section 6-1 for detailed instructions.

Now that you have set up the PCM Trunk Type, press the **OPTION MENU** key, enter the number **4** from the keypad, and press **ENTER**. The **DIGIT RECEIVER** main menu will appear:



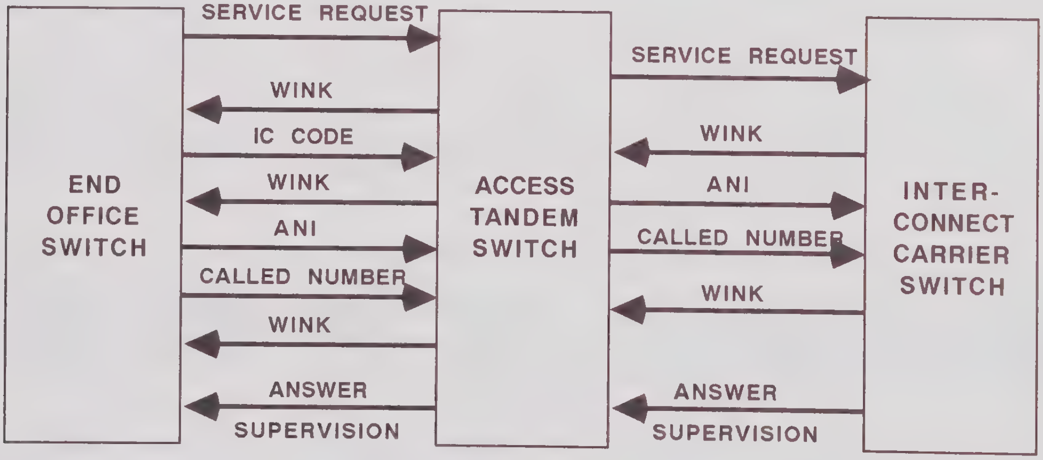
You usually check the **PARAMETERS** and **SEQUENCE** before you try to **RECEIVE** digits unless you know that your settings have not been changed from your last entries.

Press Softkey 1 (under **SET-UP**) and the main **SET-UP** display will be presented:



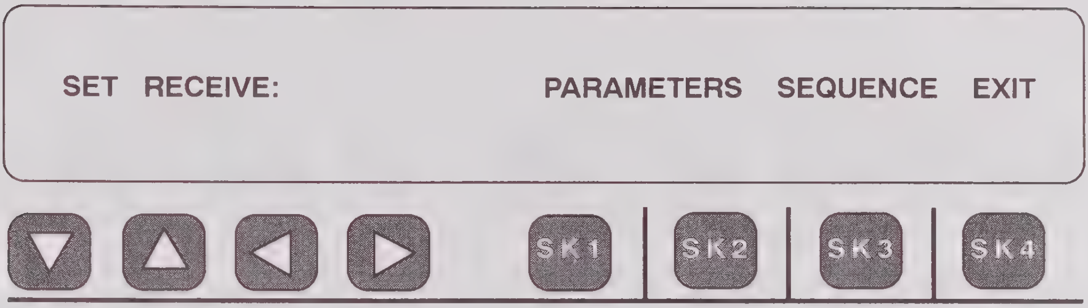
Now you need to know what a Feature Group D call progression sequence looks like, and what type of digits it is made of.

At this point, it is a good idea to refresh your memory about Feature Group D Equal Access calls into an Access Tandem.

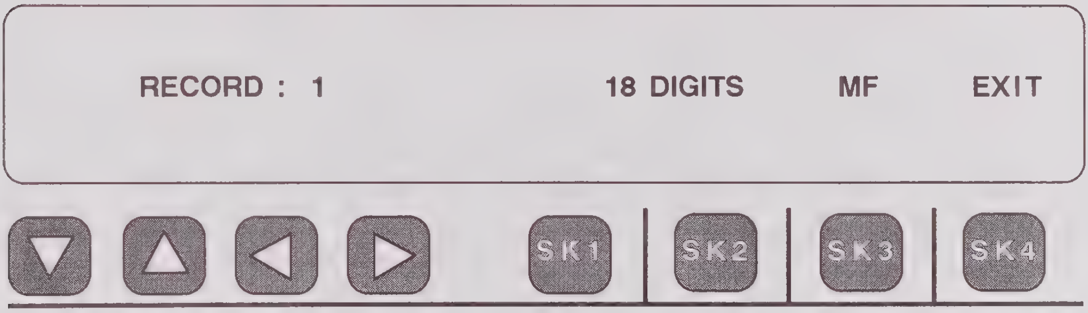


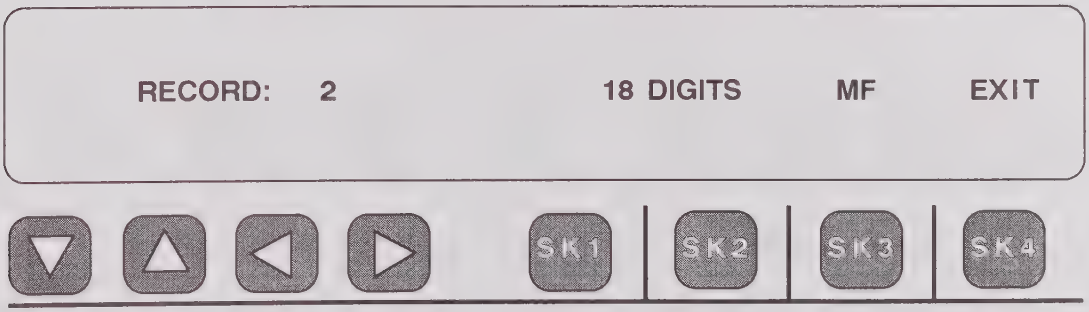
Going into the Access Tandem, the End Office supplies the customer's Long Distance, or Interconnect Carrier's code (To identify MCI, AT&T, SPRINT, etc.), the number the customer is calling from (**ANI**), and the number the customer is calling. **The call progression is:** The End Office seizes the PCM Channel; the Access Tandem responds with a Wink; the End Office sends the 6 digit IC Code; the Access Tandem gives a Wink after receiving the IC Code; The End Office sends the **ANI** followed by the **called number**; the Access Tandem gives a final Wink after receiving them; the far-end goes Off Hook when the call completes. **Now we can return to setting up the 930A.**

From the SET-UP menu:

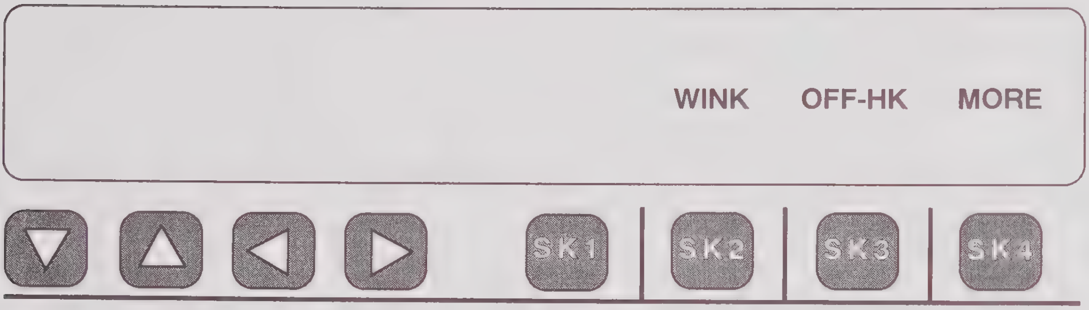


Make sure that the **PARAMETERS** are all set to **MF** digits and each of the **Records** is set to 18 digits length as described on pages 4-9 and 4-10. The displays for Records 1 to 4 should all resemble the ones below:

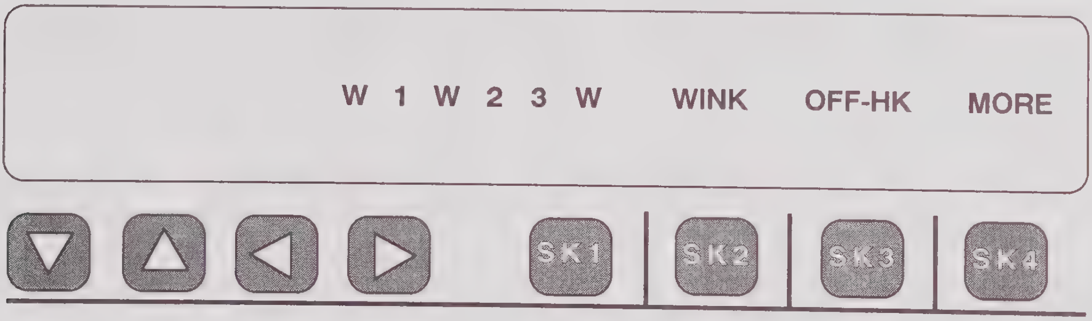

RECORD : 1 18 DIGITS MF EXIT


RECORD: 2 18 DIGITS MF EXIT

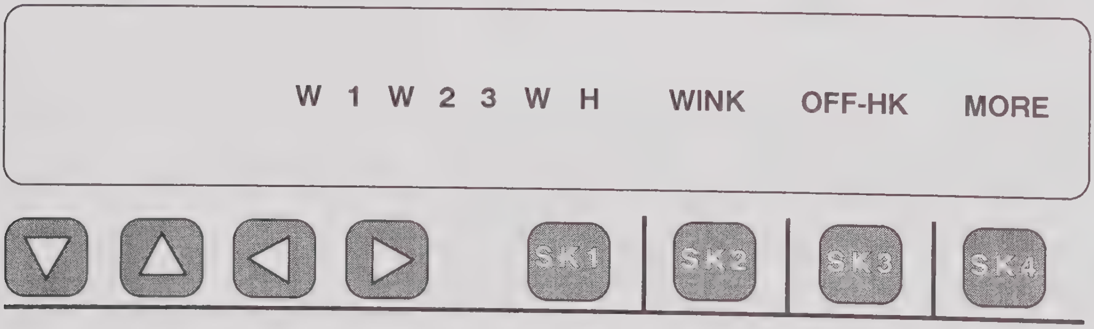
When you are satisfied that all the Records are set to expect **MF**, press Softkey 4 and **exit** back to the main **SET-UP** menu. From there you can enter the **SEQUENCE** menu shown on the following page.

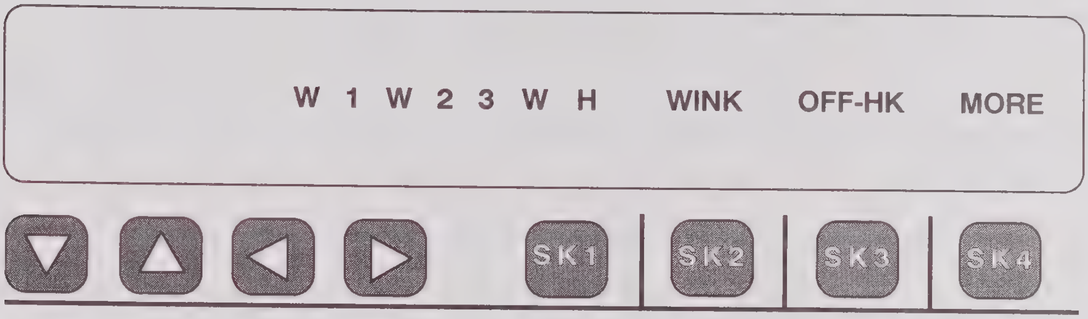


If an old sequence appears, press the **CLR** key before proceeding. Now go back to page 4-32 and look at how the call is built. It is a **Wink Start** trunk, so you begin by having the Receiver look for the **Wink** from the Tandem Office. Then you get the **IC Code**, followed by another **Wink**. The **ANI** and the **Called Number** come through next and are followed by a **Wink**. After the call completes you also get the **OFF-HOOK**. To the 930A, all this can be reduced to a simple sequence of events. **From the display above,** press Softkey 2 to enter the first Wink, then enter the number **1** for the first Record (**IC Code**), press Softkey 2 again for the second Wink, enter a **2** for Record 2 (the **ANI**), enter a **3** for Record 3 (the **called number**) and, finally, press Softkey 2 for the final Wink. The 930A display will look like the one below when you have correctly entered the call sequence:

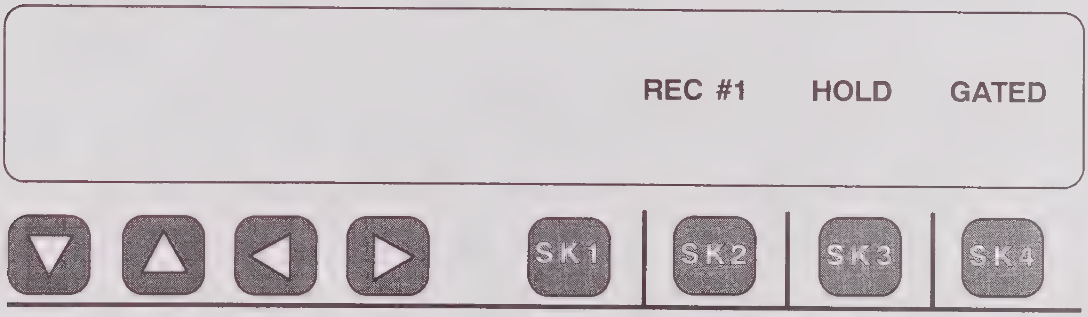


If you add an **OFF-HOOK** at the end, it will look like the following:





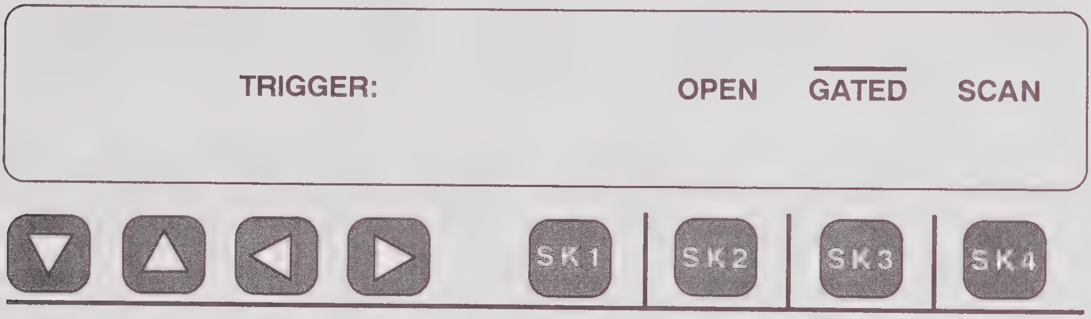
At this point, the receiver sequence is set up for a **three-stage, multi-wink, Feature Group D** call. Press the **OPTION MENU** key to return to the main menu and then press Softkey 2 to select **RECEIVE**. The 930A display will initially become:



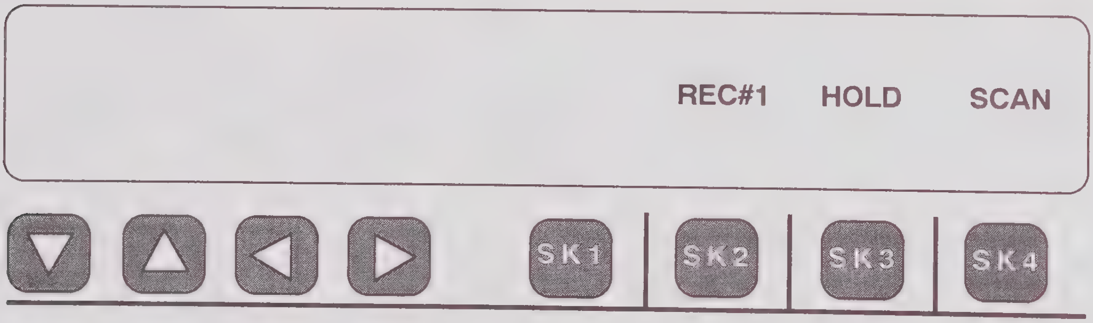
This is perfect if you have the luxury of being able to force the call to come in on the particular PCM Channel you happen to be set to. Since this is not usually the case, the 930A contains what amounts to a **"Bearcat Scanner"** mode. When activated, this mode enables the 930A to jump to the next PCM channel that goes active and capture the digits, regardless of what channel it was on before. This mode is described in the following paragraph.

4-2.4.1 USING THE DIGIT RECEIVER SCAN MODE

To activate the **SCAN** mode, press Softkey 4 (under **GATED** in the display on the previous page), and the **TRIGGER** display wil appear:



The cursor is flashing over the previous selection which was **GATED**. Press Softkey 4 (under **SCAN**) to activate the **SCAN** mode. The display becomes:



Do not worry if the display says REC#2 or #4 instead of **REC#1** because this is a random display until the Trunk is seized. The first group of digits becomes Record # 1 and so on.

The 930A will now jump to the next PCM Channel that goes **OFF-HOOK** and begin to capture digits. This saves you guessing which Channel to set the 930A to, and waiting for that channel to be seized.

The SCAN mode only works with the 930A in PCM Trunk Type since there is no need for it on an analog Trunk.

After you have received the call sequence, press the **OPTION MENU** key to back out of the **RECEIVER**. Select the **ANALYZER** to review the digits as described in the previous examples.

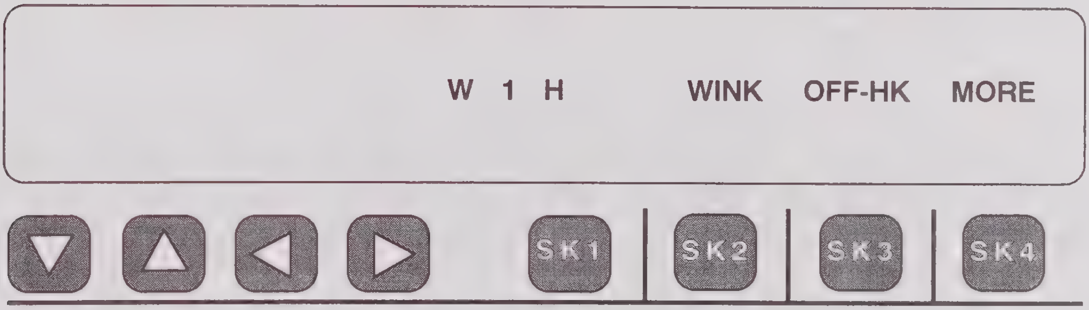
4-2.5 MORE ABOUT EQUAL ACCESS CALLS

The previous example was meant to show you how to set up the 930A to receive a full Feature Group D call at the input to an Access Tandem from an End Office.

What does this sequence look like at the output of the Tandem toward the Interconnect? What does the sequence look like from a "smart" End Office?

Without too much detail, you now know that the digits are going to be **MF**, regardless of what the sequence looks like, because you are connected between switches in this case. This means that all you have to do is change the **SEQUENCE** part of the **SET-UP** menu. Another piece of information is the fact that it is still a **Wink Start** Trunk, whether it is a **T-1** or an **E&M Type I, II, or III**.

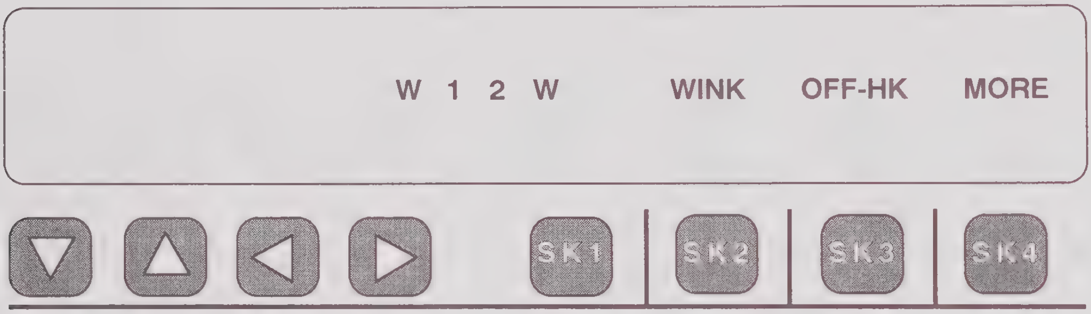
If the call is coming toward you from a "smart" End Office that strips off the **IC Code** and the **ANI** information before it gets to you, all you have left is the **Called Number**. This reduces the sequence down to a one-stage **Wink Start** call. The 930A **SEQUENCE** display would be set to:



Then you repeat the procedure for getting out of this menu and into the **RECEIVE** display.

If you are testing at the output of the Tandem Office toward the Interconnect Carrier, instead of on the End Office side of the Tandem, then the sequence is a little different. Assume that the End office is not a "smart" office and the full Feature Group D sequence of the previous example has come into the Tandem. What does it do with the information? The Tandem uses the IC Code to route the call toward the designated Interconnect Carrier. But once it has chosen the proper facility, the information is no longer needed. Why tell AT&T or MCI, etc., their own codes? They know who they are. So the Tandem drops this bit of information on the outgoing side. This leaves us with the Calling Number (**ANI**) for billing, and the **Called Number** to complete the call sequence. **Refer back to page 4-32 for a diagram of the call progression.**

Putting all this together, you can enter the following call progression sequence into the 930A **SEQUENCE SET-UP** display:

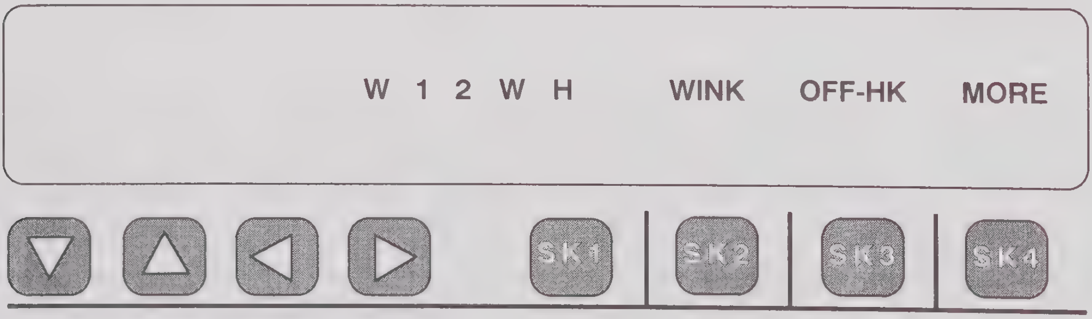


Pressing Softkey 2 inserts a Wink (**W**). The keypad and the **ENTER** key enter the numbers. The **1** represents the first record in the sequence which should be the **ANI**. The **2** represents the second record in the sequence which should be the **Called Number**. This is the back half of the full Feature Group D sequence which was:

W 1 W 2 3 W

In that case, the first record was the **IC Code**. Now it is no longer there, so the **ANI** becomes the first record. **The form of the Sequence is still the same.** As you can see, **you have to know the format** of the calls.

If you want to check the answer supervision, add an **OFF HOOK** at the end of the sequence so it looks like:

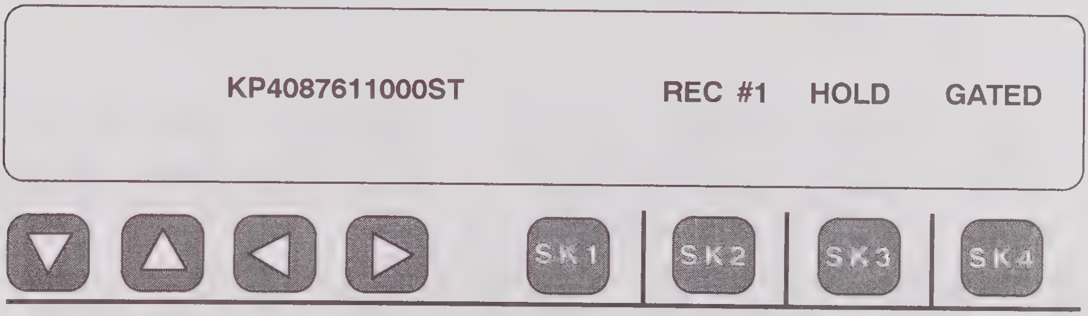


4-2.6 MORE ABOUT ANALYZING RECEIVED DIGITS

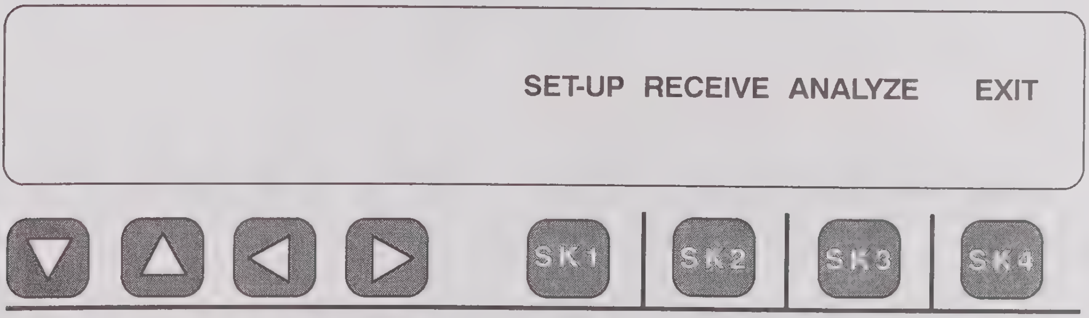
You can analyze the digit parameters, including "**E**" or Error digits, **after** they have been received. You back out of the **RECEIVE** function by pressing the **OPTION MENU** key and then select the **ANALYZE** function. You can analyze the **levels** of the low and high tones of **MF** and **DTMF** sequences as well as their **frequencies** and **ON** and **OFF times**. The user can analyze the **% Break**, **Pulses per second** and **Interdigit timing** of Rotary or Dial Pulse sequences. The amplitude and frequency of up to two additional spurious tones are measured if present.

For instance, the nominal **ON** and **OFF** times for **DTMF** pulses are 50 milliseconds each. Received **DTMF** records from a "good" source would be expected to be within a few milliseconds of the nominal 50 millisecond value. Values far outside the nominal, or large discrepancies between digits in the same record string, are symptoms of signaling troubles.

Using the example of a single **MF** digit sequence received in the **GATED** mode, a display would look like:

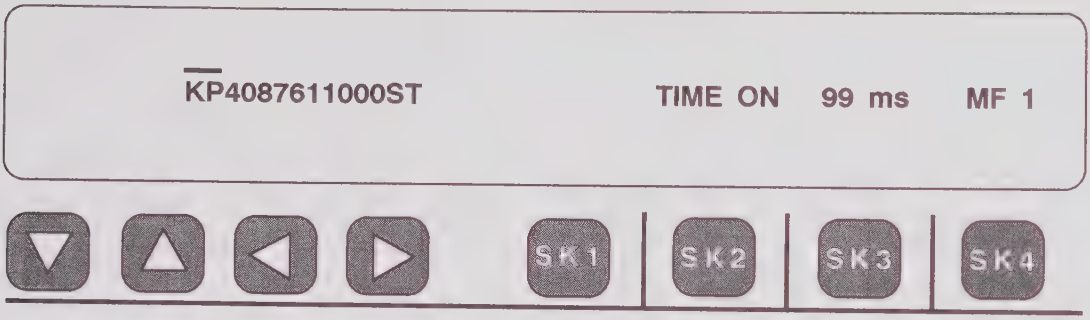


To analyze the digits, press the **OPTION MENU** key and the display is:



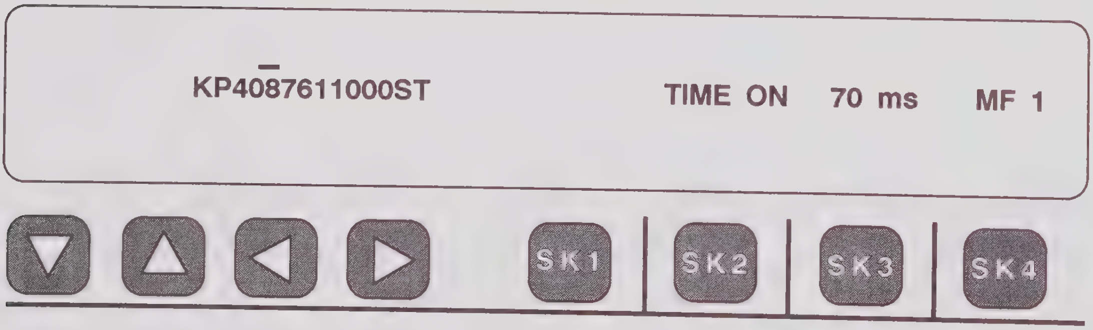
Now, press Softkey 3 to get into the **ANALYZE** menu.

An example of an **ANALYZE** display is shown below:



This example shows the previously received **MF** record. The cursor over the "**KP**" shows that it is the digit currently being measured. In this case the **ON** time of the **KP** pulse measured 99 milliseconds.

Use the LEFT/RIGHT ◁ ▷ arrow keys to position the cursor over other digits you want to measure.

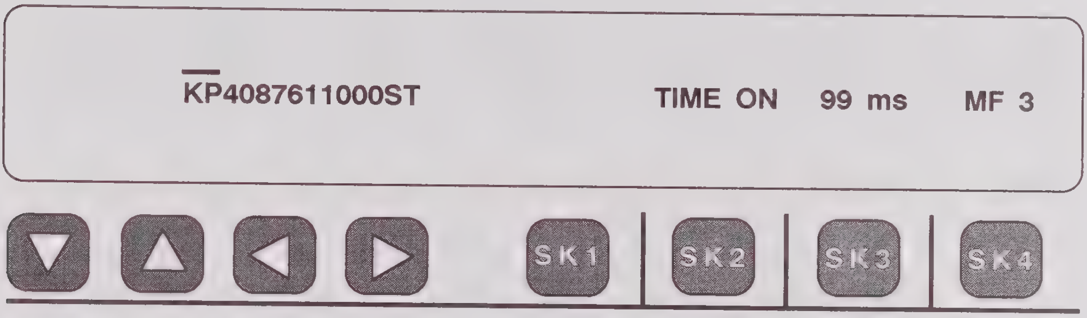


Use the UP/DOWN ▽ △ arrow keys to scroll from the **TIME ON** to the **TIME OFF** measurement value and so on through the amplitude and frequency values.

Softkeys 1 and 3 are inactive.

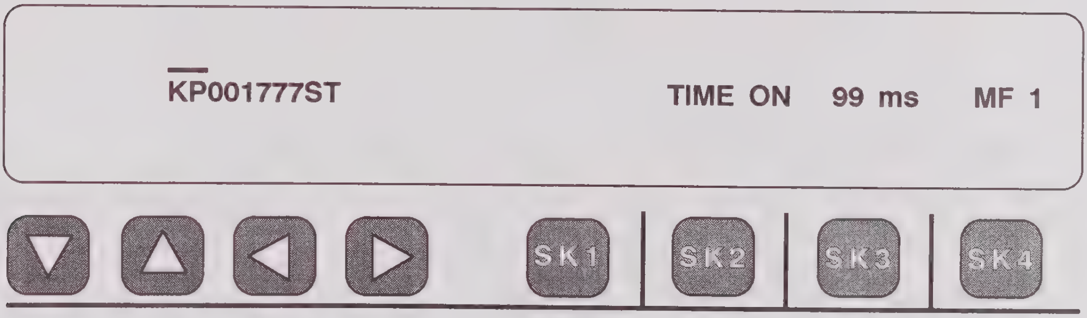
Press Softkey 4 to change which Record (1-4) is displayed.

As an example consider a **Feature Group D MF** call sequence received under the **RECEIVE** function. After exiting to the primary receiver display and selecting **ANALYZE**, the 930A display shows the last Record it received first. **The Called Number** display example is:



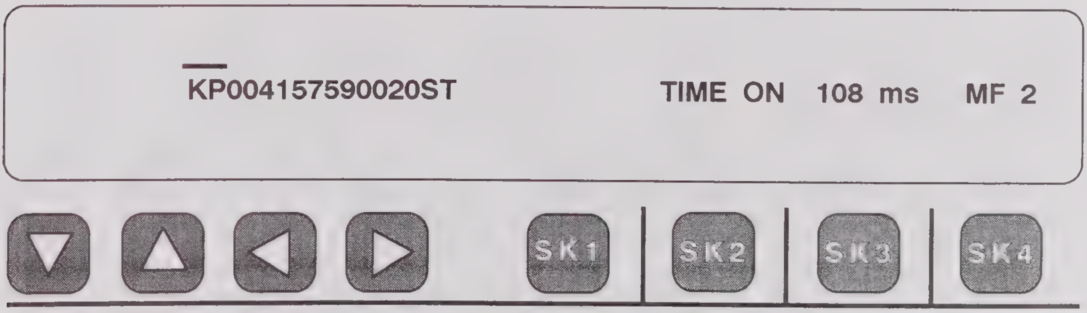
KP4087611000ST TIME ON 99 ms MF 3

Press Softkey 4 to page through the Records to **MF Record 1**. This would be the **IC Code** and an example might be:



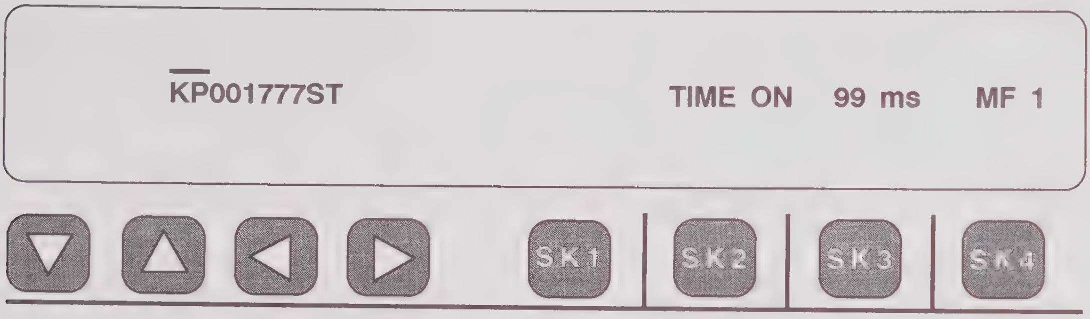
KP001777ST TIME ON 99 ms MF 1

Press Softkey 4 again to page up to **MF Record 2** which would be the **ANI** (or the number from which the call was placed) in our example:



KP004157590020ST TIME ON 108 ms MF 2

After a brief check of each Record you are ready to analyze each digit starting back with the first **KP** of **MF 1**.

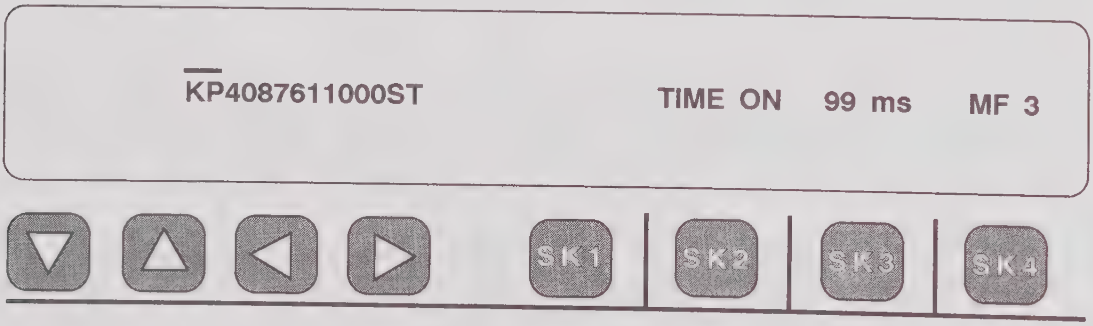


Pressing Softkey 2 will scroll you through all of the parameter measurements of the digit over which the cursor is flashing. It always starts over the first digit or **KP** in this case. Use the **RIGHT** Arrow key to move the cursor over the next digit (a **0** in this case) and then press Softkey 2 to scroll through it's parameter values. Repeat this process for any of the digits you are interested in.

Press Softkey 4 to go to the other received records and repeat the process to analyze their digits.

After you do this once or twice, you will appreciate the value of having a **Printer** connected to the 930A.

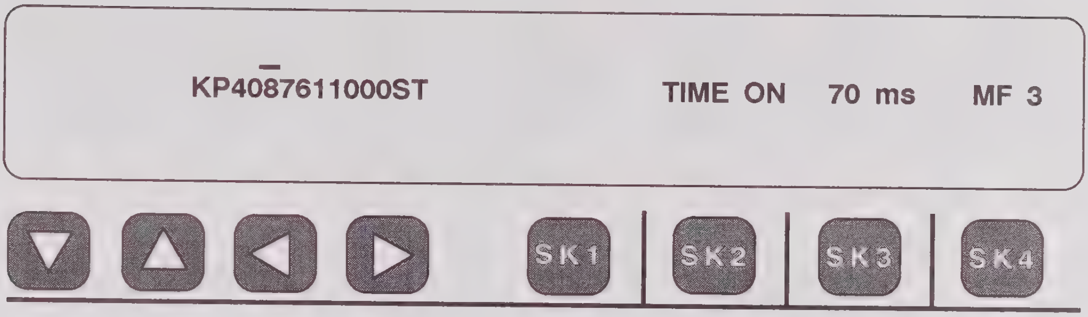
To get some idea of the digit analysis process, let us examine the "**8**" in the third **MF** Record (the **Called Number**) below:



The first step is to move the cursor over the "**8**".

Use the RIGHT ▷ arrow key

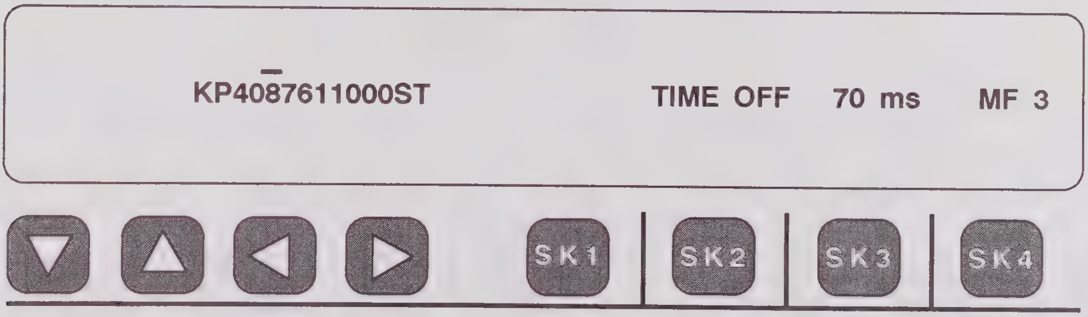
to position the cursor over the "**8**" and the display will change to:



KP4087611000ST TIME ON 70 ms MF 3

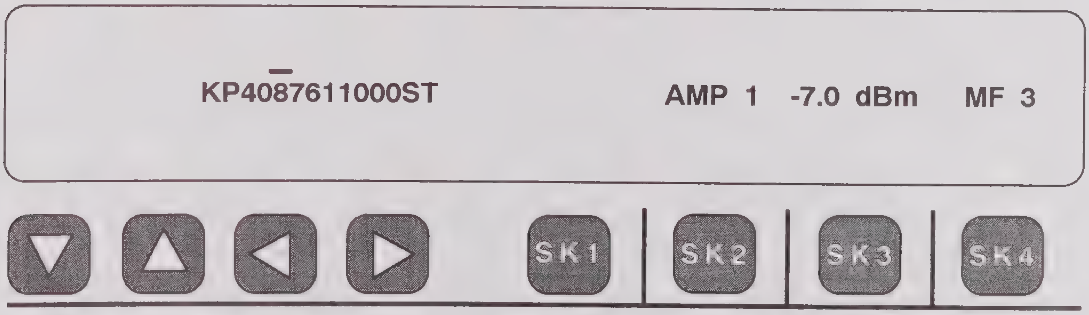
Starting with the **TIME ON**, you can go through the other parameters by pressing Softkey 2. A series of sample displays of each parameter follow:

TIME OFF



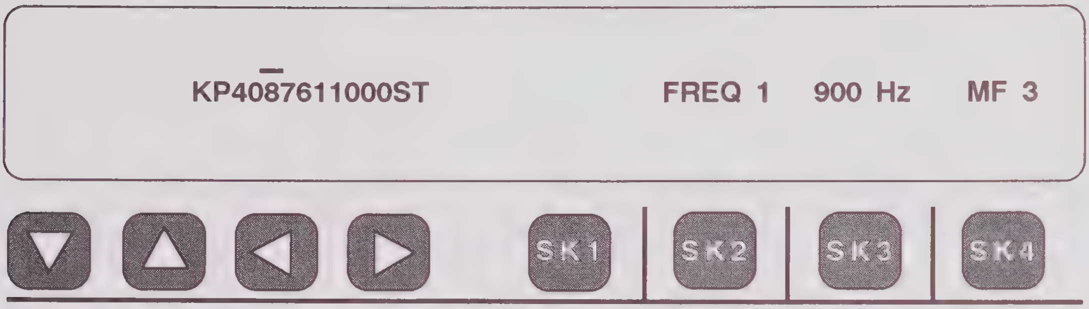
KP4087611000ST TIME OFF 70 ms MF 3

LOW TONE AMPLITUDE

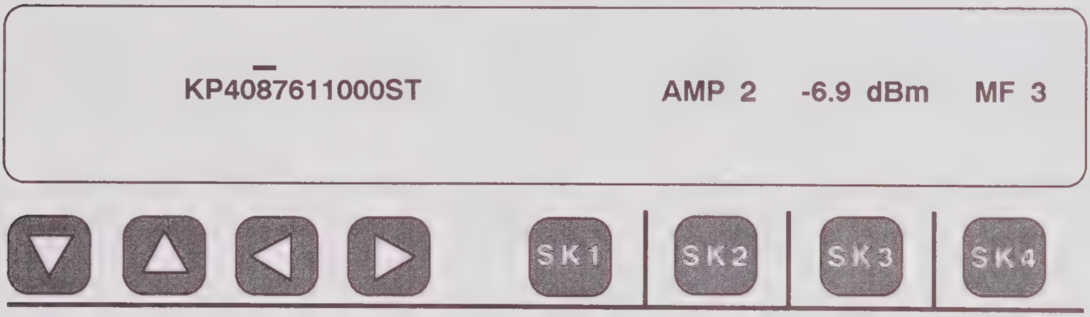


KP4087611000ST AMP 1 -7.0 dBm MF 3

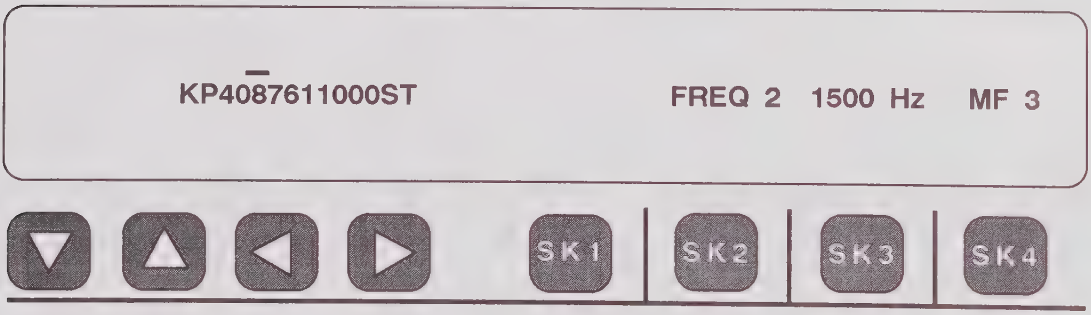
LOW TONE FREQUENCY


KP4087611000ST FREQ 1 900 Hz MF 3

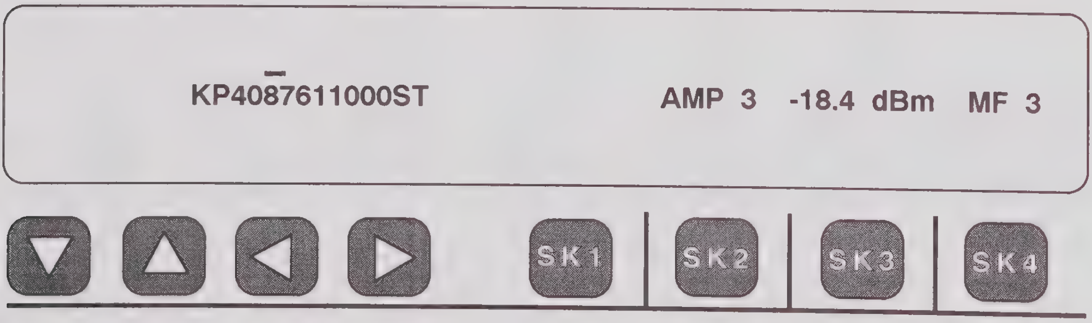
HIGH TONE AMPLITUDE

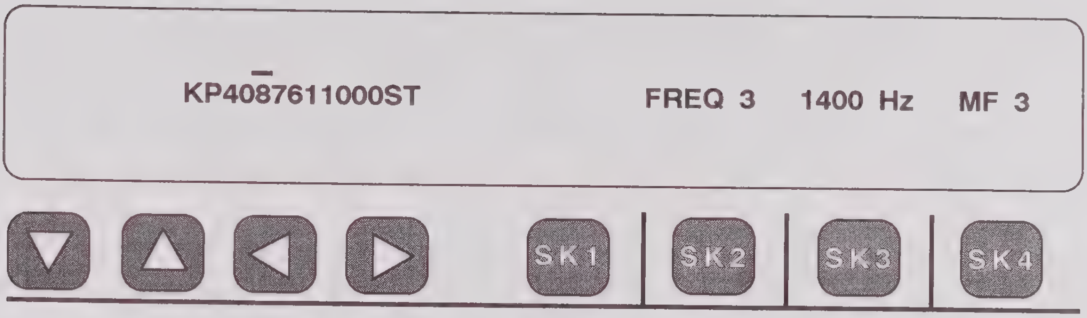

KP4087611000ST AMP 2 -6.9 dBm MF 3

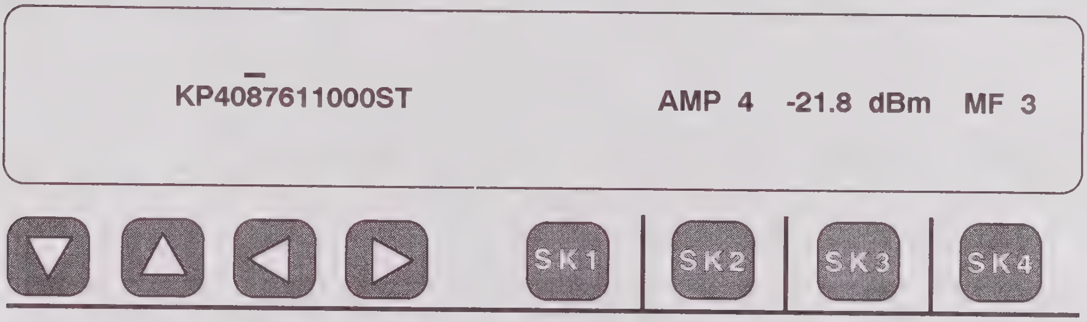
HIGH TONE FREQUENCY

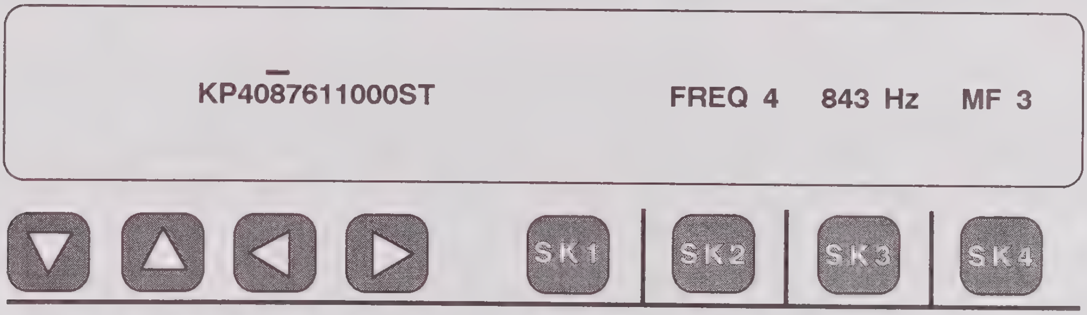

KP4087611000ST FREQ 2 1500 Hz MF 3

If any spurious tones are present, the display would look somewhat like:


KP4087611000ST AMP 3 -18.4 dBm MF 3







The Model 930A analyzes up to four tones in the **ANALYZER** mode. The first tone is the **Low Tone** of the **MF** or **DTMF** digit. The second tone will usually be the **High Tone** of the **MF** or **DTMF** digit. **Tones 3 and 4 will only** be displayed if spurious tones are present. These tones are not necessarily related to the normal High and Low tones of the digits. If there are no spurious tones present, the 930A will momentarily show the locations of these tones, but there will be no measurements and the display will immediately return to the **TIME ON** display.

You can also use the **UP/DOWN** Arrow keys to scroll through the various measurements, until returning to the starting point (**TIME ON**). **Remember** that under normal circumstances, there will be no display of a third or fourth tone. These are displayed only when spurious tones are present.

In actual use, the received digits will be less than perfect. In fact, some or all of the digits may be so badly mutilated that even the 930A will not be able to interpret them. In such a case, the 930A display will show an "**E**" instead of the received digit. Such displays are discussed in the example which follows.

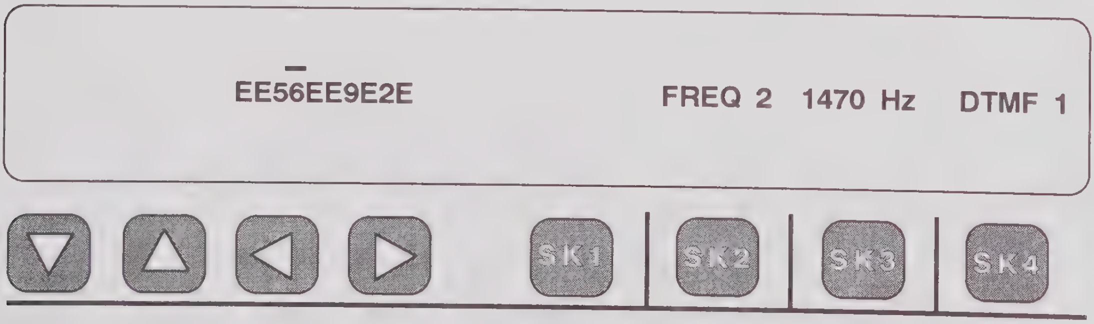
The nominal values of the MF, DTMF and DP digits are also listed.

Given the analyzing power of the 930A, it seemed like a good idea to provide you with some information on what the proper levels, frequencies, On/Off times, % Breaks, and Rates should be. You will be able to spot a bad reading when the 930A gives it to you. The information presented in this section comes from a number of sources including AT&T Practices and Bellcore Documentation. It applies to all Trunk Types, so there is no specific example of test set-up. Only the Digit Analyzer is described with the interpretation of it's readings. It is assumed that you have gone through the examples and are able to set up the Digit Receiver to capture digits.

4-2.6.1 EXAMPLES OF DIGIT ANALYSIS

When analyzing a string of received digits it is quite possible that some of the digits may be so badly mutilated that they are not recognizable. This can be caused by any number of things including; defective sending equipment, pressing two keys at the same time and causing more than two tones to be sent in **MF**, and weak **DTMF** keypad springs in older Touch-Tone phones, which distort the digits.

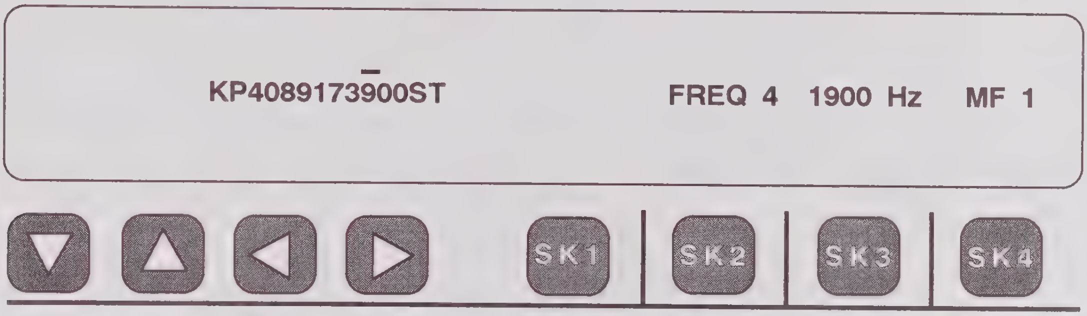
A typical display of distorted digits might appear as follows:



```
EE56EE9E2E          FREQ 2  1470 Hz   DTMF 1
```

A number of the **DTMF** digits were so distorted the 930A put an "**E**" for Error in their place. If you know what digits were actually sent this may help to determine the cause of the problem. For instance, suppose that the string of digits was sent as **4156779124**. An examination of the High and Low group frequencies making up these tones shows that the item common to each of the missing digits is the 1209 Hz High tone. This may be due to low amplitude, a defective keypad or any number of items. **The complete Table** of **DTMF** Frequencies is on page 4-50.

In the next example, a 930A placed on the interoffice trunk between two switches displays more than the expected MF digits. The display shows two extra tones at unexpectedly high amplitudes. An example display of one of the extra tones is shown below:



```
KP4089173900ST          FREQ 4   1900 Hz   MF 1
```

In this case, our first inclination is to suspect that the tone may be an actual **MF** tone, perhaps caused by a generator stuck on. An examination of the **MF** tone frequency table, however, shows us that the **MF** tones are combinations of 700, 900 1100, 1300, 1500 and 1700 Hz. So, where did the 1900 Hz come from?

Whenever more than one frequency is present, the possibility of intermodulation products is a consideration. The mathematical formula used for computing first order intermodulation products has the form 2A-B or 2B-A, where, in this case, A and B are any of the **MF** tone frequency pairs.

Consider the tone pair 1100 Hz, 1500 Hz (**MF digit 9**) and let A=1100 Hz and B=1500 Hz. In this case, 2B-A becomes (2x1500)-1100=1900 Hz. So now we know that the tone is related to the **MF** digits, but we do not know why.

The fact that this spurious tone was the result of an intermodulation product is important. Intermodulation products require a nonlinearity to be produced. This is used for constructive purposes in Mixers. However, nonlinearities can appear under uncontrolled circumstances. In our example, we have chosen to look at a trunk between two switches. Suppose one switch is a new digital machine, while the other is an older analog type.

If the output levels of the tones from the analog switch are "hot," they can easily over-drive the input circuits of the digital switch. The digital switch, being new, uses integrated circuits which are basically collections of transistors. These devices can provide the nonlinearity quite easily if they are over-driven. This is not an uncommon problem and requires the technician to check the levels coming from the analog switch and set them back to normal levels acceptable to the digital switch. The correct values of tone levels for the digits is about 6 or 7 dB below the TLP.

4-2.6.2 MULTIFREQUENCY (MF) PARAMETER VALUES

It is important to note that **MF** is only found on trunks between switches. It is **not** used on the subscriber side of a switch toward the customer premises. It is how the central office switches along a calling path "talk" to each other. **MF** consists of 15 digits which are listed in Table 4-2 along with the nominal frequencies of the tone pairs which form them.

TABLE 4-2
MULTIFREQUENCY (MF) CODES

		SIGNALS		
FREQUENCIES (Hz)	DIGIT AND CONTROL	EXPANDED INBAND	CCITT NO. 5	TSPS/EQUAL ACCESS
700+900	1			
700+1100	2	COIN COLLECT		
700+1300	4			
700+1500	7			
700+1700		RINGBACK	CODE 11	ST3P (ST''')
900+1100	3			
900+1300	5			
900+1500	8	OPER. RELSD		
900+1700			CODE 12	STP (ST')
1100+1300	6			
1100+1500	9			
1100+1700	KP	COIN RETURN	KP1	
1300+1500	0	OPER. ATTCHD		
1300+1700			KP2	ST2P (ST'')
1500+1700	ST	COIN COLLECT OPER. RELSD		ST

The discrete tones of the **MF** oscillators are seen to be 700, 900, 1100, 1300, 1500, and 1700 Hz. These frequencies should be within ±1.5% of their nominal values or the switch may declare them in error. The measurements of **MF** tones you make with the 930A digit analyzer should fall within the following ranges to be accepted as correct:

700 ± 10 Hz
900 ± 13 Hz
1100 ± 16 Hz
1300 ± 19 Hz
1500 ± 22 Hz
1700 ± 25 Hz

The signal duration, sometimes referred to as Interdigit time, or **ON/OFF** time, varies with the type and vintage of the switching equipment. Most modern digital switches have a nominal 68 to 70 millisecond interval for **MF** digits with a range of 58 to 75 milliseconds. The Key Pulse (**KP**), however, typically lies between 90 and 120 milliseconds. Receivers are designed to receive a **KP** signal of 55 milliseconds minimum duration.

The nominal **KP**, and other **MF** digit intervals, for several commonly used switching machines are shown in Table 4-3.

TABLE 4-3
MF SENDER INTERDIGIT INTERVALS

SWITCHING SYSTEM	KEYPULSE (Milliseconds)	NORMAL PULSE ON/OFF TIMES (MS)	
Step-By-Step		100 ± 10	68 ± 7
No. 1 Crossbar		100 ± 10	68 ± 7
No. 5 Crossbar		100 ± 10	68 ± 7
Crossbar Tandem	100 ± 10	68 ± 7	
No. 4 Crossbar		100 ± 10	68 ± 7
No. 1/1A ESS		120 ± 0.5	60 ± 0.5
No. 2E/2B ESS		100	75
No. 3 ESS	100	70	
No. 4 ESS	100	70	
No. 5 ESS	110	70	
DMS-10	100 ± 10	68 ± 7	
DMS-100F	100	70	

The 930A default values for sending **MF** digits are; 100 milliseconds for the **KP ON** and 70 milliseconds **ON/ OFF** for the other digit's pulse times.

The output levels of the tone oscillators also vary with the vintage of the equipment. Older switching systems send at 6 dBm below the 0 dB Transmission Level Point (TLP) per frequency. If these tones are sent from a -16 dB TLP, their actual level is -22 dBm, or - 6 dBm0. You may hear a switch referred to as a "6 dB" office. Newer equipment transmits at -7 dBm relative to the TLP, or -7 dBm0. The tolerance is ±1 dBm and the levels of the two tones received should be within 1 dB of each other for each digit. Also, any spurious tones should be at least 30 dB below the level of the desired tones over a 3 KHz band. **The 930A default send level is 7 dBm below the TLP.**

4-2.6.3 TOUCH-TONE (DTMF) PARAMETER VALUES

Dual-Tone Multifrequency (DTMF), or Touch-Tone, provides a method of pushbutton dialing from customer station equipment to the telephone Central Office switch. Prior to **DTMF** there was only Dial Pulse, or rotary dial, station equipment. With **DTMF**, dialed digits are composed of two non-harmonically related tones. The nominal values of these frequencies are shown below:

		HIGH GROUP FREQUENCIES (Hz)			
		1209	1336	1477	1633
LOW GROUP FREQUENCIES (Hz)	697	1	2	3	A
	770	4	5	6	B
	852	7	8	9	C
	941	*	0	#	D

The digits are composed of one tone from the Low Group and one from the High Group. **For example, the digit 9 in DTMF** would consist of the 852 Hz and 1477 Hz tone pair. Receiving equipment in the Central Office is designed to accept and register digits that are within ± 1.5% of the nominal frequency values. Receivers should be designed not to register digits if either tone frequency deviates more than ± 3.5% from the nominal frequencies.

Receiving equipment should register **DTMF** digits as short as 40 milliseconds **ON** and 40 milliseconds **OFF**. The shortest **Tone ON** plus **Tone OFF** interval which must be accepted is 93 milliseconds. Digits less than 23 milliseconds duration should be rejected.

The nominal **DTMF** tone level is -7 dBm ± 0.5 dBm per frequency, relative to the 0 dB TLP, which is the 930A default. Receiving equipment should register digits over a -25 to +0 dBm range and reject digits if either frequency's level is below -55 dBm.

4-2.6.4 DIAL PULSE (DP) PARAMETER VALUES

Dial Pulse or Rotary Dial customer station equipment is another means of transmitting digit information from the customer to the Central Office switch.

Modern dial pulse equipment is designed to a **Break ratio** of 58 to 64%. The 930A default value is 60%. The **pulsing rate** or speed is 10 ± 0.5 PPS in new equipment with a 700 millisecond **interdigital time** interval. An accuracy of ± 5% is considered satisfactory in this interval although modern switches are capable of accepting intervals as fast as 70 milliseconds and as slow as 1000 milliseconds.

Older equipments were manufactured to wider tolerances and can be expected to range from 7.5 to 12 PPS speeds and 59.5 to 67.5% Break.

Some 20 PPS equipment is still in use and may be expected to range from 17 to 21 PPS speed and 62 to 66% Break.

The interdigital time of 700 milliseconds is the recommended interval and should be used to prevent call failures. When analyzing **DP** with the 930A, look for intervals much shorter than 700 milliseconds as a possible cause of call failures.

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4-2.7 TO MARGIN THE WINK DURATION OF THE 930A (MENU OPTION 12)

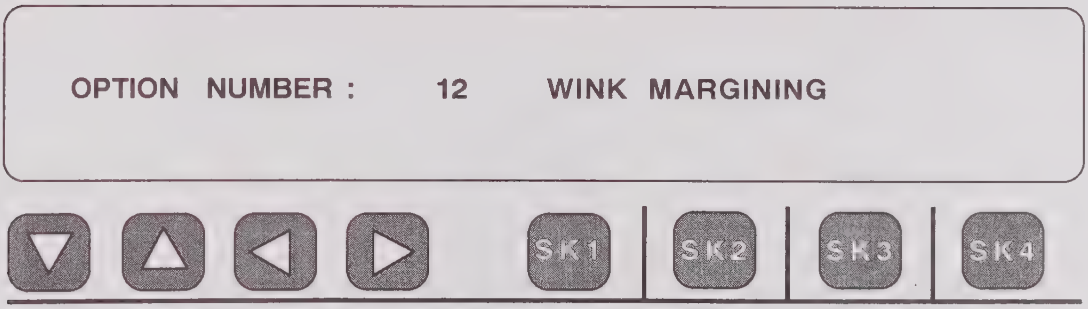
The Model 930A includes **Wink Margining** as part of Option 930A-01 (**MF, DTMF, and DP Receiver/Analyzer**). **Wink Margining** lets you change the default of the length of time the 930A will wait (200 milliseconds) after it sees a seizure before it gives back a **Wink**. This is called the **Pre-Wink** time or **Guard** time. You can also change the duration or length of the **Wink** itself (150 millisecond default).

You select Menu Option 12 in the same manner as any other Menu Option by the following steps:

Press the OPTION MENU function key.

Use the UP/DOWN ▽ △ arrow keys to select Menu Option 12: WINK MARGINING.

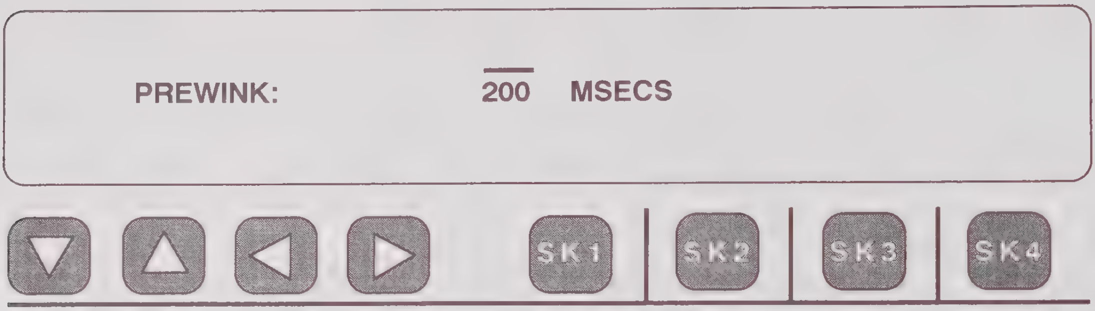
The 930A display will appear as shown below:



OPTION NUMBER : 12 WINK MARGINING

You get inside the Menu Option by pressing any softkey under the display.

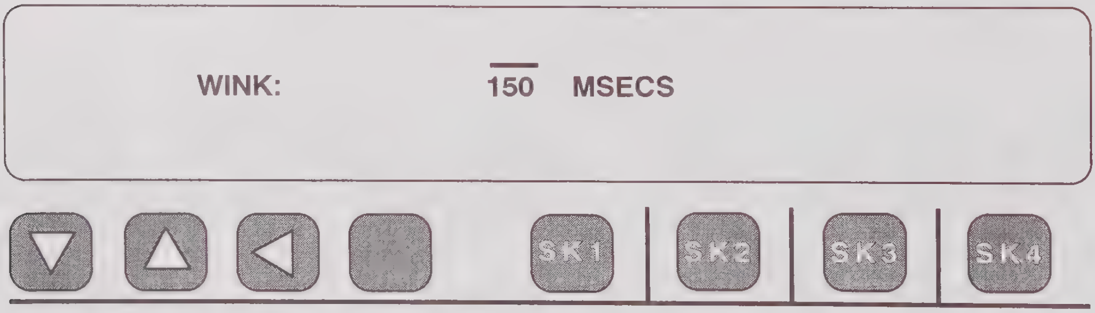
Inside Menu Option 12, the display will first show either the default value of the "**Pre-Wink**", or the last value entered.



PREWINK: 200 MSECS

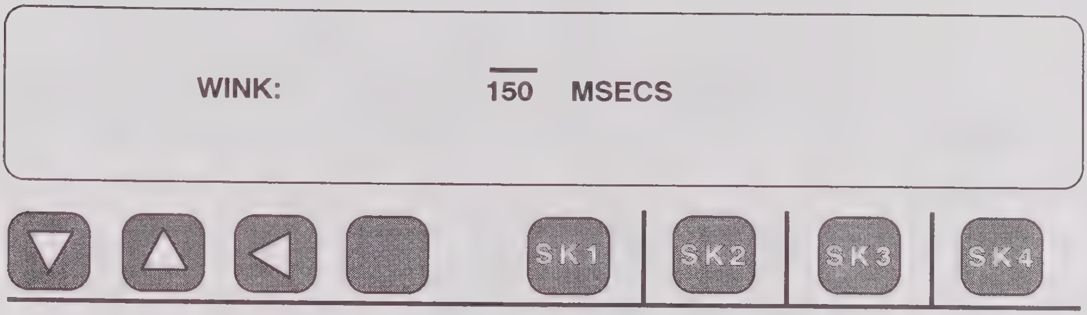
The "**Pre-Wink**" time is the number of milliseconds the 930A will wait after line seizure (or the end of a record) before giving a wink. The range of permissible values lies between 55 and 995 milliseconds. The factory set default value is 200 milliseconds. This Menu Option has a resolution of 10 msecs. and an accuracy of ±10 milliseconds. The front panel keys function as follows: To change the displayed **Pre-Wink** time, you enter the value you want from the keypad and then press the **ENTER** key. If you want to keep the default value, press **ENTER** or any softkey. In either case the display will advance to the **Wink** time.

The display will then read the **Wink Time** default value of 150 milliseconds, or the last value entered:



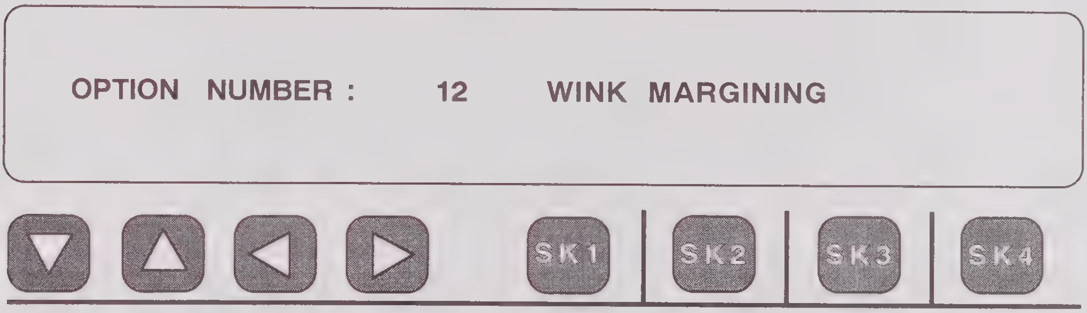
WINK: 150 MSECS

This is the number of milliseconds the 930A will remain Off-Hook during a Wink. The range of permissible values lies between 35 and 995 milliseconds. The factory set default value is 150 milliseconds. The accuracy is ± 10 milliseconds and the resolution is 10 milliseconds.

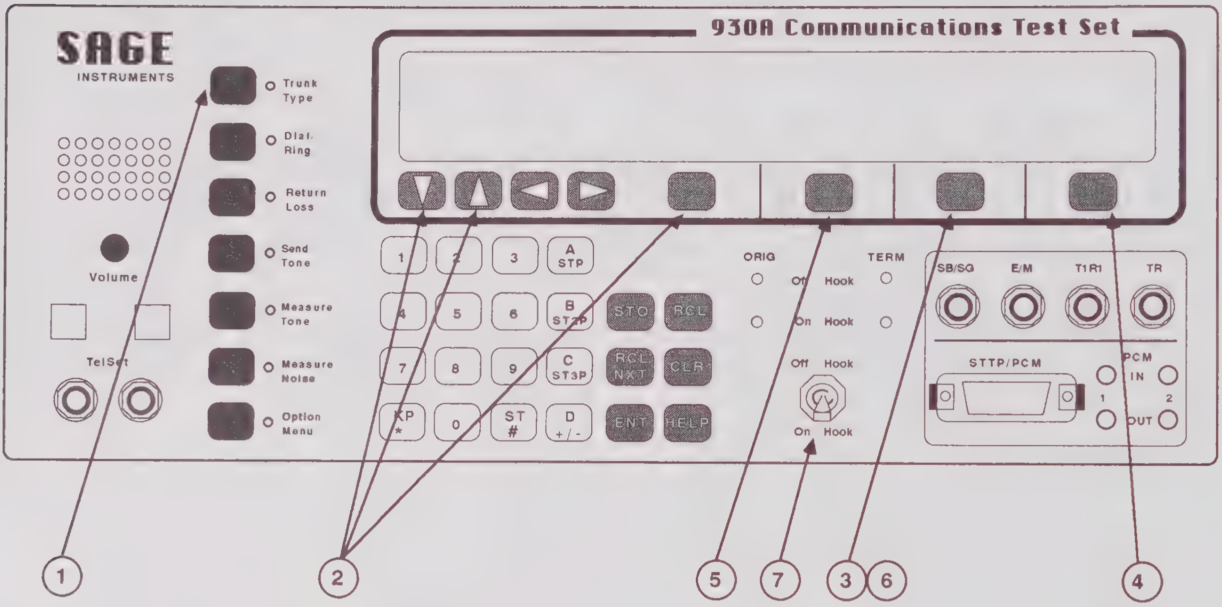


WINK: $\overline{1}50$ MSECS

To change the displayed value of the **Wink**, enter the value you want the 930A to use from the keypad, and press **ENTER**. If you want to keep the default, just press **ENTER**, or any softkey. Either action will exit to the Option Menu.



OPTION NUMBER : 12 WINK MARGINING



To select **SF Supervision** Trunk Type:

1. Press the **TRUNK TYPE** function key.
2. Press Softkey 1 or use the **UP/DOWN** arrow keys to select the display entitled "**OPTIONAL TYPES**".
3. Press Softkey 3 (under **SF**) to select **SF Supervision**.
4. Press Softkey 4 to select the impedance (usually **4W 600**)
5. Press Softkey 2 to send on **Tip/Ring** or **Tip1/Ring1**.
6. Press Softkey 3 to select either **BRIDGE** or **TERM**inate operation.
7. Use the Hook Switch to go "**Off Hook**".

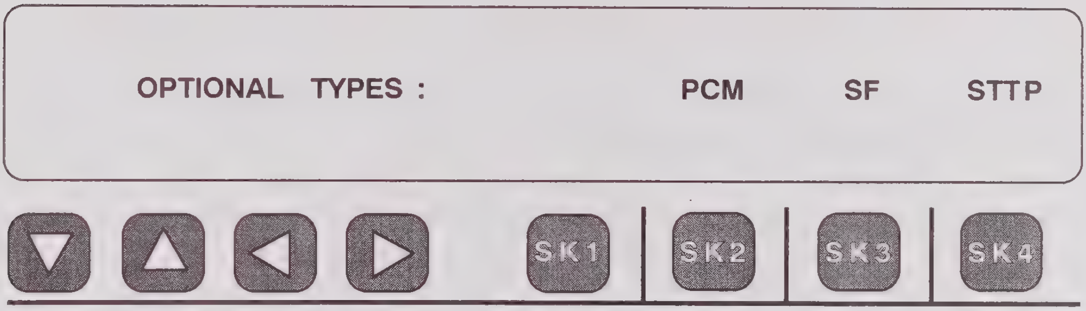
SF TRUNK TYPE SELECTION
FIGURE 4-2

4-3 SF SUPERVISION (OPTION 930A-02)

If Option 930A-02 **SF SUPERVISION** has been installed in the Model 930A, it can be accessed under the **TRUNK TYPE** key.

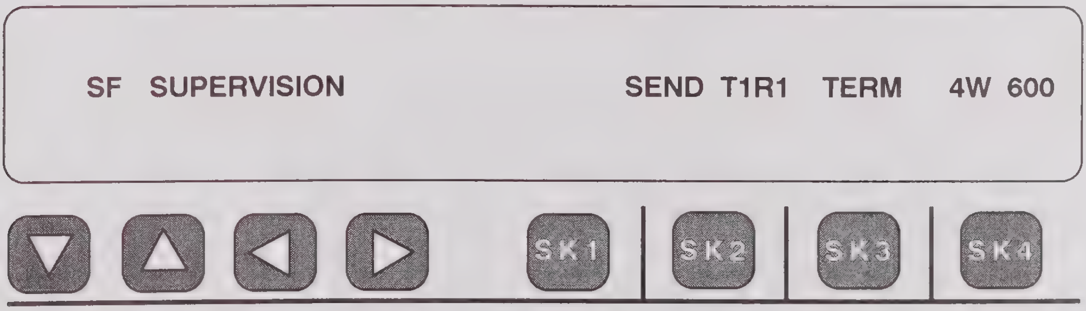
Press the Trunk Type ○ Trunk Type function key to display the currently selected Trunk Type.

Use the UP/DOWN ▽ △ arrow keys to page through the available displays until the following display appears:



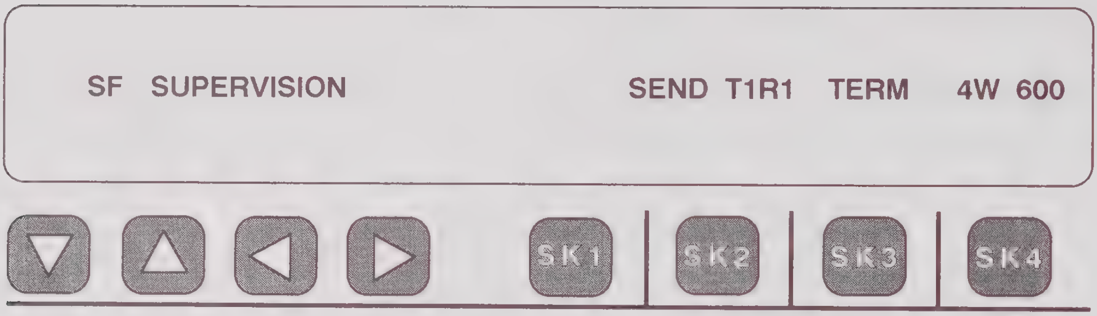
OPTIONAL TYPES : PCM SF STTP

Press Softkey 3 (under **SF**) to enter the **SF** Supervision Trunk Type. An example display is shown below:



SF SUPERVISION SEND T1R1 TERM 4W 600

Single Frequency (SF) supervision sends a 2604 Hz tone to indicate an **On-Hook** condition. It is inherently a 4-wire trunk type and is now mainly used on special service trunks in the U.S. It has been largely displaced in the network by CCIS and SS7 signaling types.



The front panel keys operate as follows:

The Arrow keys and Numeric keypad are inactive.

Softkey 2 toggles the Send direction between **TR** and **T1R1**.

Softkey 3 toggles between **BRIDGE** (Monitor) and **TERM** (Simulate).

Softkey 4 acts as a wheel allowing you to choose 150, 600, 900, or 1200 ohm transmit and receive impedances.

In practice, the impedance selected will most often be 600 ohms which is the typical 4-wire line impedance for analog transmission.

The Model 930A does not presently support 2-Wire SF systems which use 2 tones (2404 and 2604 Hz, for example), nor can it be used to provide SF supervision on PCM systems. The SF option in the 930A does not support FXS/FXO supervision on SF trunks either. Future enhancements to the 930A may include these capabilities.

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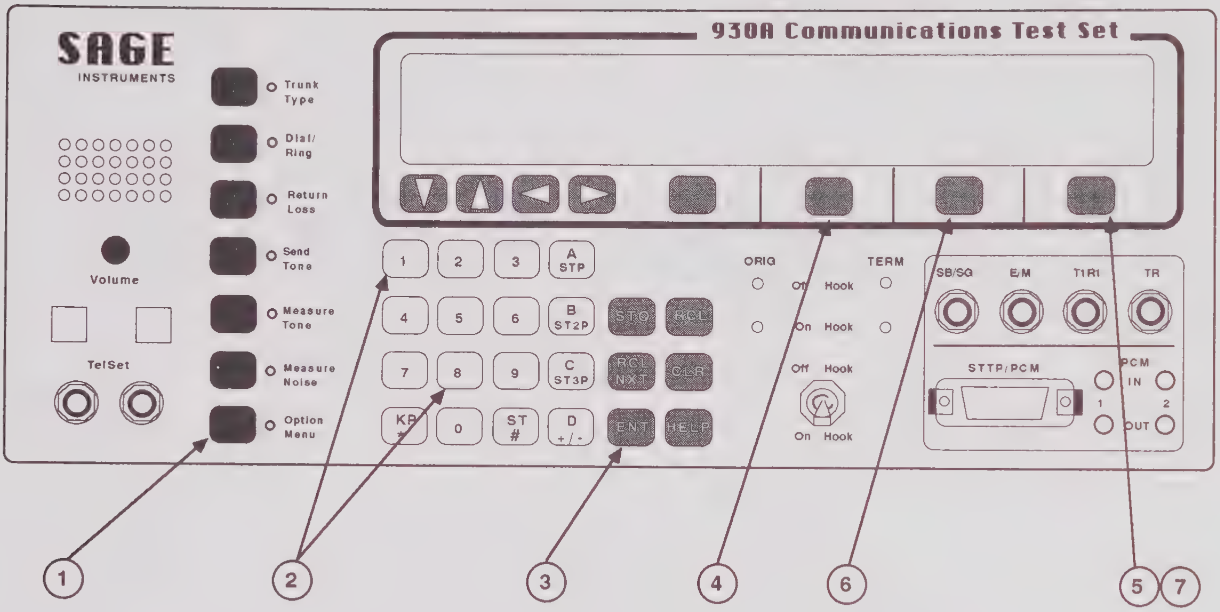


To select the **P/AR** measurement option:

1. Press the **OPTION MENU** key.
2. Use the numeric keypad to enter the number 18.
3. Press the **ENT** (Enter) key to complete the numeric entry.
4. Press Softkey 2 (**SEND**) if the Transmit level is to be changed, or to send the **P/AR** signal on a 2-wire circuit.
5. Press Softkey 4 (**EXIT**) to stop test and return to main menu.
6. Press Softkey 3 (**MEASURE**) to send **P/AR** waveform and measure received **P/AR** on 4-wire circuits.
7. Press Softkey 4 to **exit** from the Menu Option and stop testing.

P/AR MEASUREMENT OPTION
FIGURE 4-3

4-4 PEAK TO AVERAGE RATIO (P/AR) (OPTION 930A-06) (MENU OPTION 18)

With Option 930A-06 installed in your 930A, you can measure **P/AR** values over a 0 to 120 P/AR unit range.

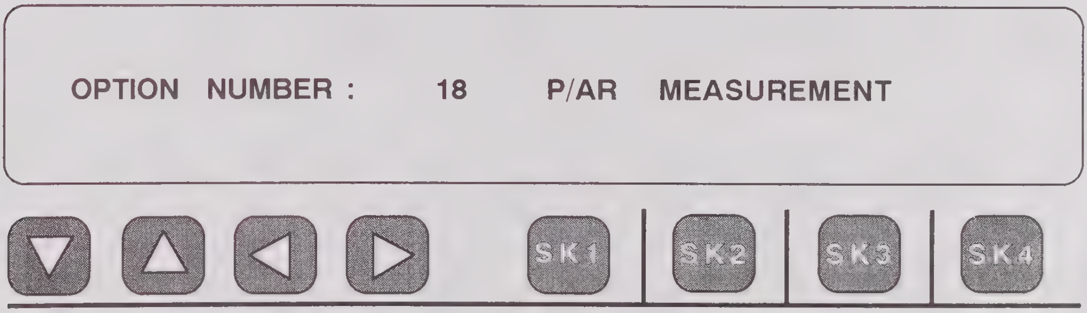
You connect the 930A to the circuit under test at the 2- or 4-wire analog trunk access point, or **DEMARC**. **It can also be used on a T-1 PCM** Trunk at the **DSX** with Option 930A-08E or -09E. Test cord connection diagrams are shown in Sections 3-4.4, 6-4 and 6-5. **Before making a P/AR test**, set the 930A Trunk Type to the correct settings as described in Sections 3-4 and 6-1.

To begin making P/AR measurements, perform the following steps:

Press the OPTION MENU ■ ○ **Option Menu** function key.

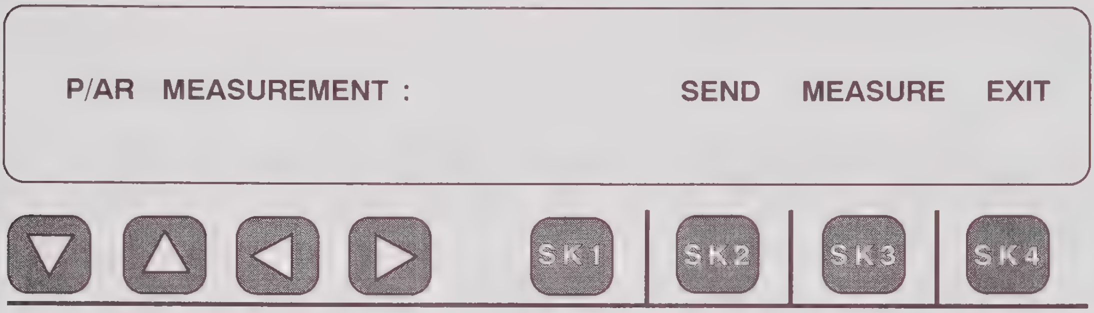
Use the UP/DOWN ▽ △ arrow keys to select Menu Option 18: P/AR MEASUREMENT.

The Model 930A display will appear as shown below:



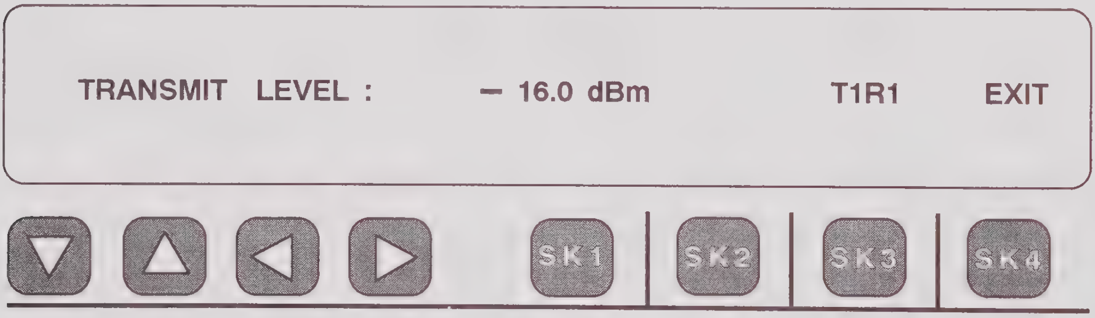
OPTION NUMBER : 18 P/AR MEASUREMENT

Press any softkey under the display to get into the main menu:

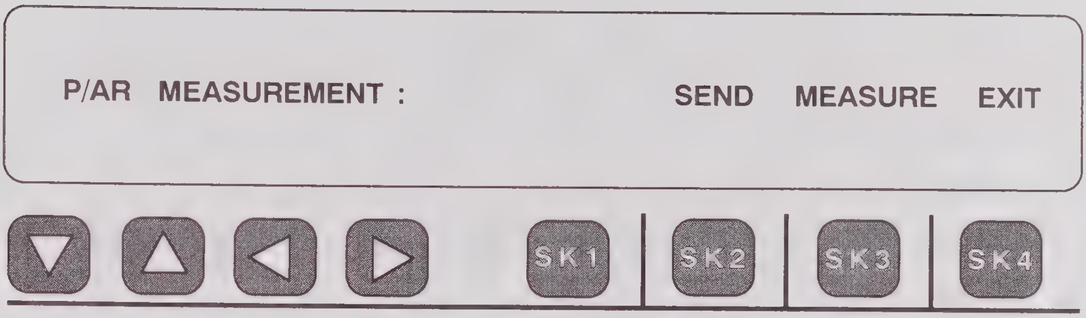


Softkey 2 (SEND) controls the set-up of the **P/AR** transmitter level and also sends the **P/AR** signal on 2-wire circuits. **The set-ups are retained** in non-volatile memory and need not be accessed every time a measurement is made, unless the level is to be changed.

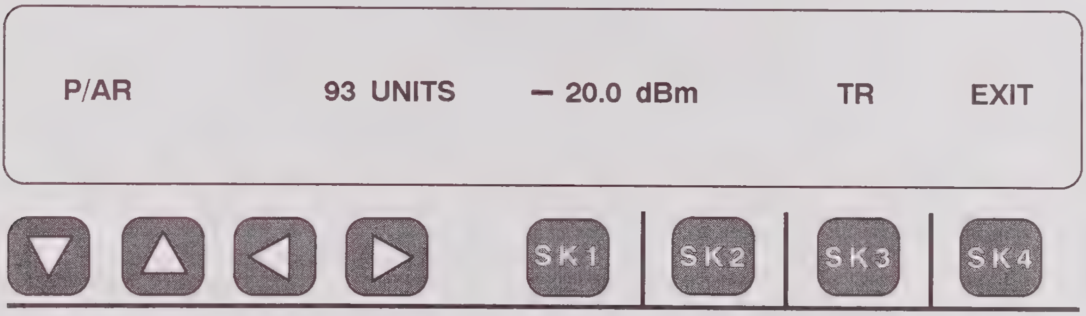
Pressing Softkey 2 (SEND) brings up the **P/AR** transmit level display. The default **SEND** display is shown below:



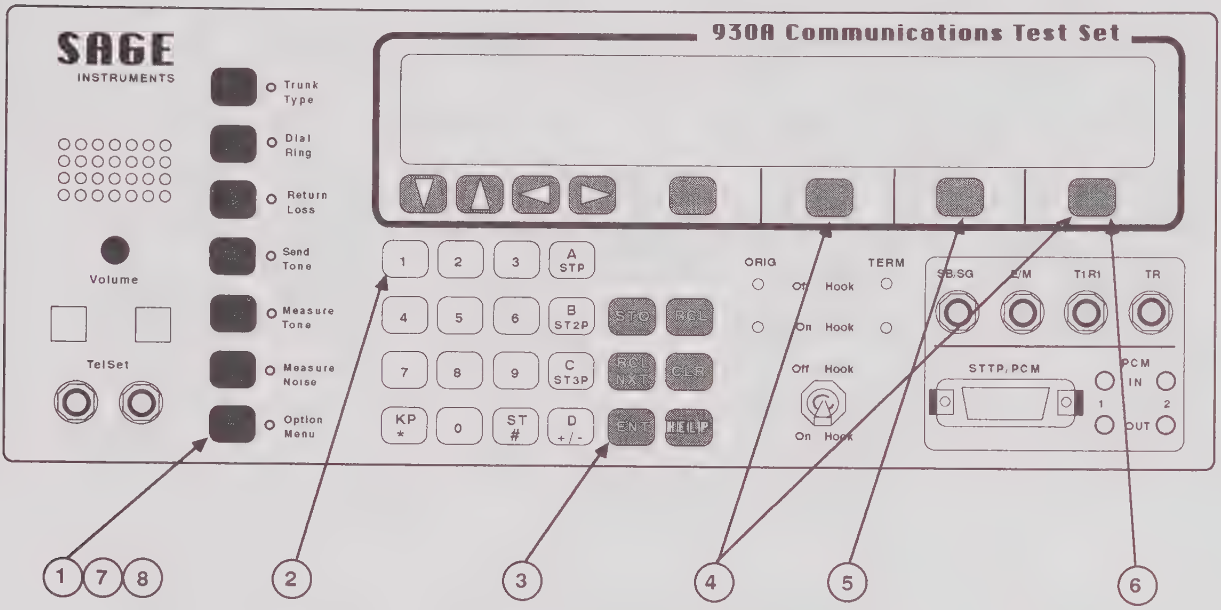
The test set at the far end of the circuit would receive and display the **P/AR** measurement. Normally, transmit levels are kept below -13 dBm, relative to the 0dB TLP, to prevent adjacent channel interference. **Select the desired level** using the numeric keypad and complete the data entry by pressing the **ENTER** key. **Pressing Softkey 4 (under EXIT)** in the above display turns off the transmitter, if the 930A is set for operation on a 2-wire trunk, and returns to the main **P/AR** display.



Once the **P/AR** transmitter level has been set, or turned off as appropriate, you can begin **sending and receiving** the **P/AR** waveform on a 4-wire circuit, **or receiving P/AR** on a 2-wire circuit, by pressing **Softkey 3 (MEASURE)** in the above display. Pressing Softkey 3 brings up the **P/AR** measurement display. A **P/AR** measurement display is shown below:



It is important to note that **P/AR** measurements are end-to-end measurements. **On 2-wire circuits**, one end transmits while the other receives, and then the sender and receiver switch places. **On 4-wire circuits** , simultaneous transmitting and receiving is possible. **When measuring P/AR on 2-wire circuits**, one of the test sets must have it's transmitter turned off and act as a receiver only.



To select the **3-Level Impulse Noise/Hits** measurement:

1. Press the **OPTION MENU** function key.
2. Use the numeric keypad to enter the number 11.
3. Press the **ENT** (**Enter**) key to complete the numeric entry.
4. Press Softkey 2 (under **DEFAULT**) for factory settings of Impulse Noise and Hits parameters, or Softkey 4 (under **SET-UP**) to change the default settings.
5. Press Softkey 3 (under **MEASURE**) to enter the measurement display.
6. Press Softkey 4 (under **START**) to begin measurements.
7. Press the **OPTION MENU** function key to stop testing.
8. Press the **OPTION MENU** key again to exit to the main menu.

3-LEVEL IMPULSE NOISE OPTION
FIGURE 4-4

4-5 MEASURING 3-LEVEL IMPULSE NOISE (OPTION 930A-07) (MENU OPTION 11)

The 3-Level Impulse Noise measurement option is **set up and operated** from Menu Option 11. The following step-by-step instructions demonstrate the set-up and measurement procedure. **Remember** to set up the correct **Trunk Type** as outlined in Section 3-4 before proceeding.

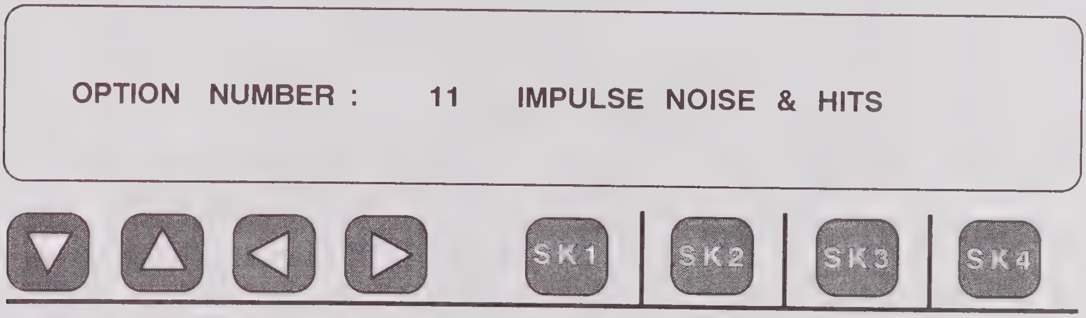
To begin:

Press the OPTION MENU ○ **Option Menu** function key.

Use the UP/DOWN ▽ △ arrow keys to

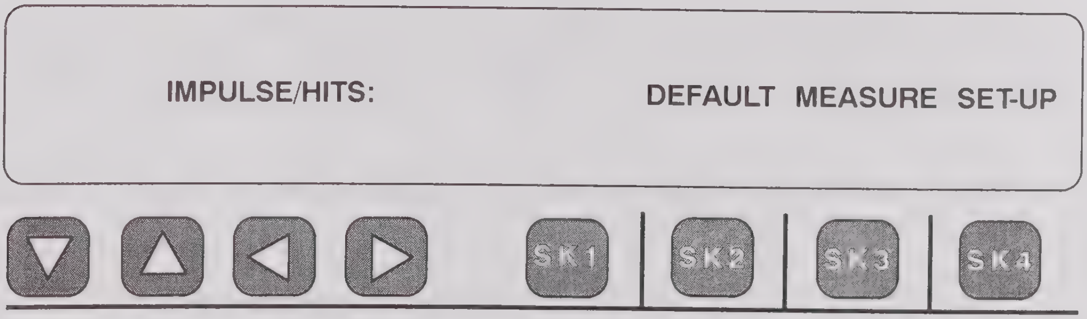
to select Menu Option 11, IMPULSE NOISE & HITS.

The Model 930A display will appear as:

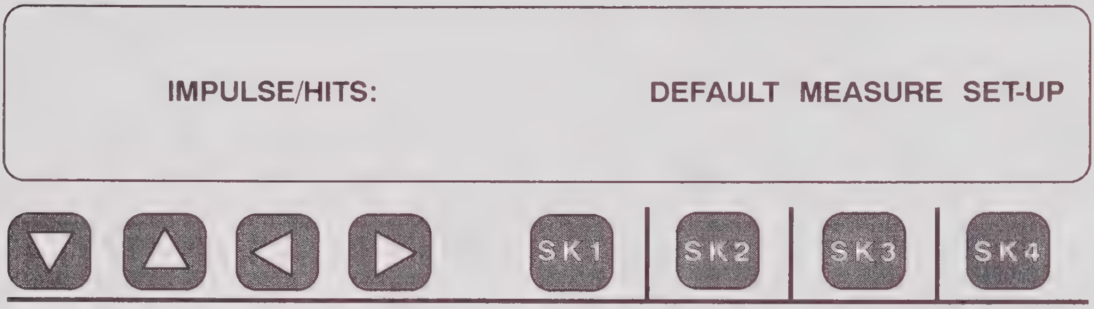


OPTION NUMBER : 11 IMPULSE NOISE & HITS

Pressing any softkey will enter the Menu Option. The main selection display appears as follows:



IMPULSE/HITS: DEFAULT MEASURE SET-UP

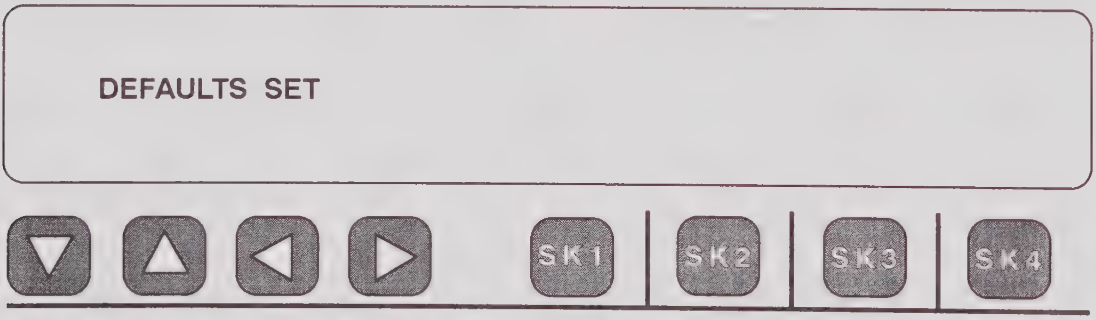


In this section, only the 3-Level Impulse Noise measurement will be described. **Phase Hits, Gain Hits and Dropouts are described in Section 4-8.2** since this added capability is obtained by purchasing Option 930A-18, in addition to Option 930A-07.

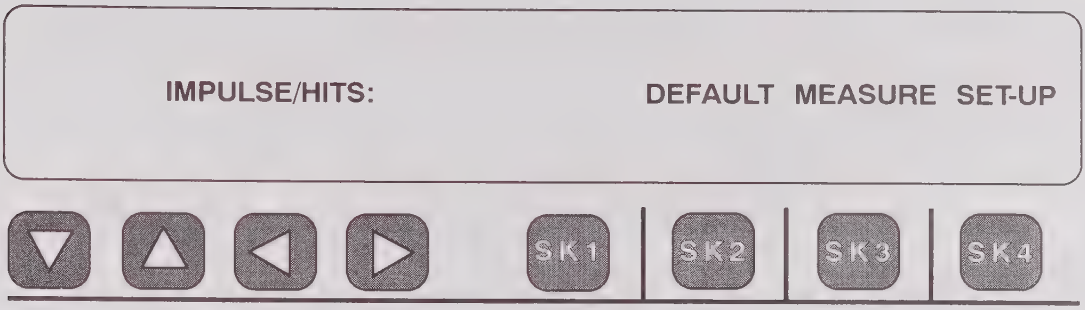
The above display offers three choices: Choosing the **DEFAULT** test parameters, begin **Measuring**, or manually **setting-up** the test parameters.

Pressing Softkey 2 (under **DEFAULT**) will set the correct default test parameters for Impulse Noise and Hits measurements on the **TRUNK TYPE** selected. The default values for Impulse Noise measurement are taken from AT&T published specifications for short haul (less than 500 mile length) Voiceband Data circuits. The default values include the fact that Impulse Noise is usually measured with the holding tone present. The tone is notched out using a C-Notch filter.

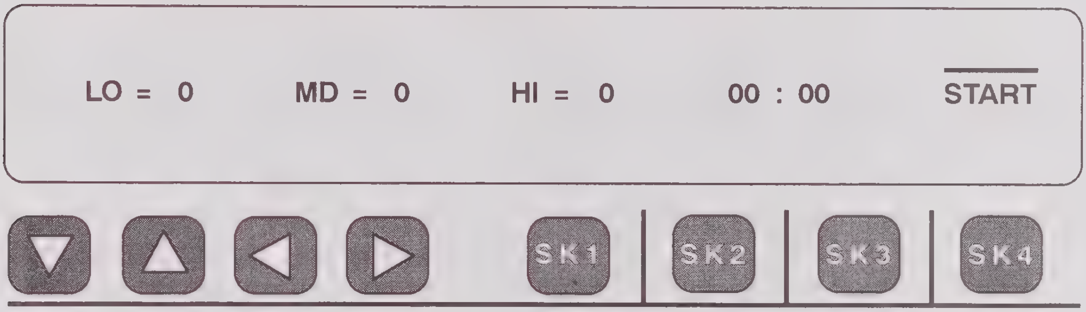
Pressing Softkey 2 (under **DEFAULT**) causes the 930A display to show:



The display will then return to the main display as shown on the next page.

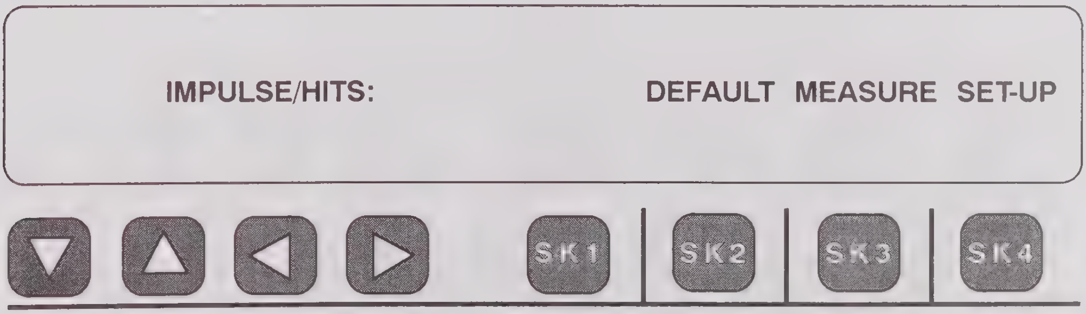


If you press Softkey 3 (under **MEASURE**), the 930A display will become:



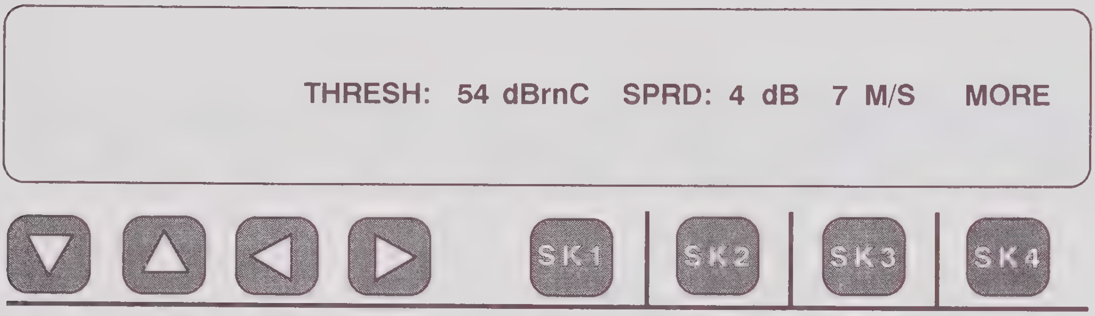
Press Softkey 4 (under **START**) to begin measurements.

If you want to use parameters other than the factory defaults, then you have to go through the manual set-up procedure. The main display is repeated below for example purposes:



The following step-by-step procedure assumes that the test parameters have not yet been set up and it is **not** desired to use the defaults.

Press Softkey 4, (under **SET-UP**), and the 930A display will appear as follows:



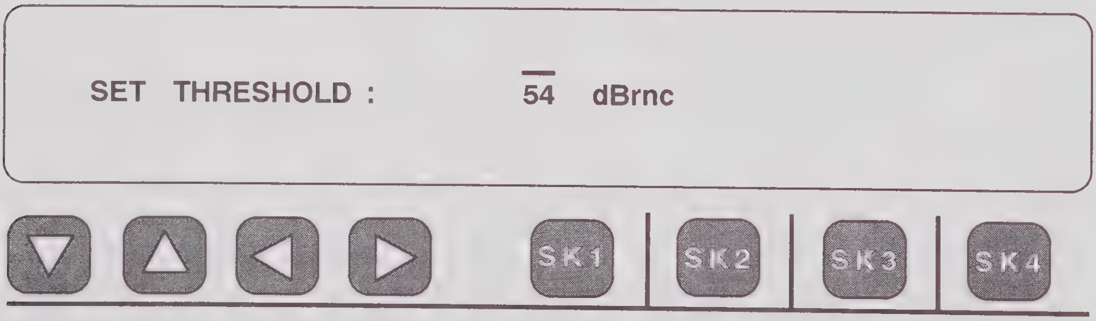
THRESH: 54 dBrnC SPRD: 4 dB 7 M/S MORE

This display presents you with the current settings of the Impulse Noise and Hits parameters and lets you make other choices. In this section, we are concerned only with setting the Impulse Noise parameters.

There are four Impulse Noise parameters which can be changed from their default values. You may change any or all of them. You start the process by pressing the softkey directly below the parameter you want to change.

Suppose you want to change all of the parameters. **To begin changing the values:**

Press Softkey 1 (under **THRESH: 54 dBrnC**) and the 930A display will change to:

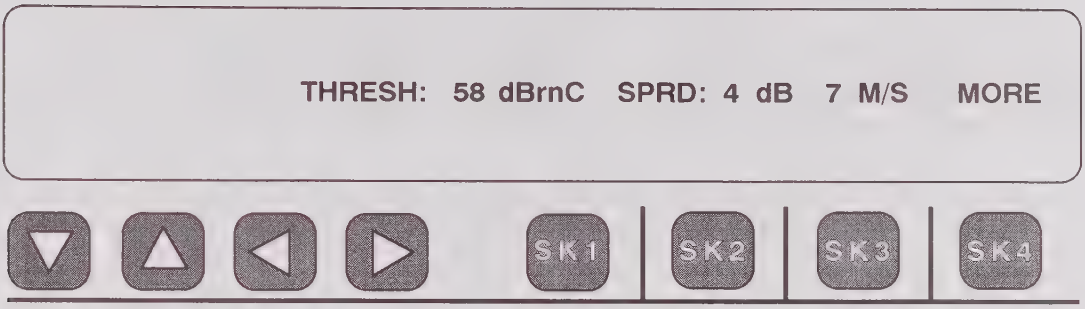


SET THRESHOLD : $\overline{54}$ dBrnc

The range of threshold settings permitted for the lowest threshold is 30 to 106 dBrnC, assuming the spread between thresholds is 2 dB. No threshold can be higher than 110 dBrnC, so a wider spread creates a lower limit for the initial threshold.

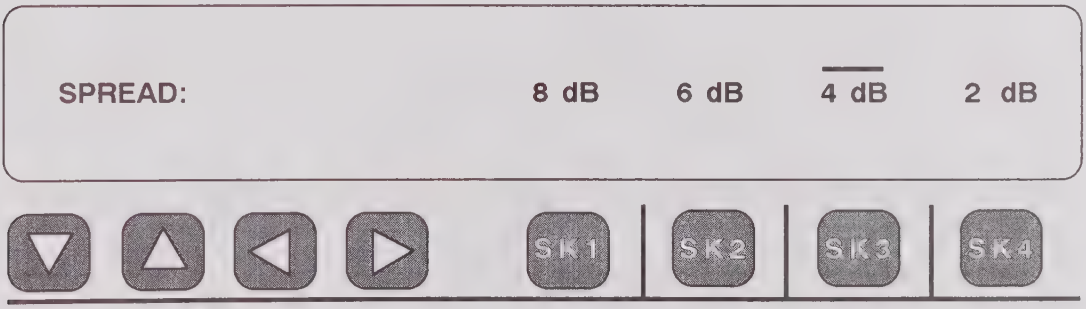
Suppose you want 58 dBrnC as the lower threshold. To change to this value, perform the following steps:

Press 5 and 8 and then ENT
and the 930A display will show:


THRESH: 58 dBrnC SPRD: 4 dB 7 M/S MORE

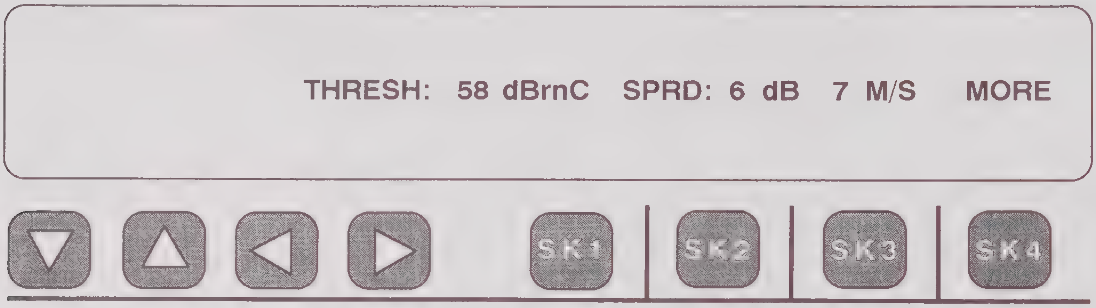
The new threshold value is now displayed and the impulse noise counters are now set to 58 dBrnC, 62 dBrnC, and 66 dBrnC since the spread is still 4 dB.

To change the size of the spread between the Low, Mid, and High impulse noise measurement counters, **press Softkey 2** (under **SPRD: 4 dB)** and the 930A display will change to:


SPREAD: 8 dB 6 dB 4 dB 2 dB

The flashing cursor appears over the currently selected step size (4 dB in this example). The step size choices range from 8 dB to 2 dB in 2 dB increments and each choice appears directly above it's associated softkey.

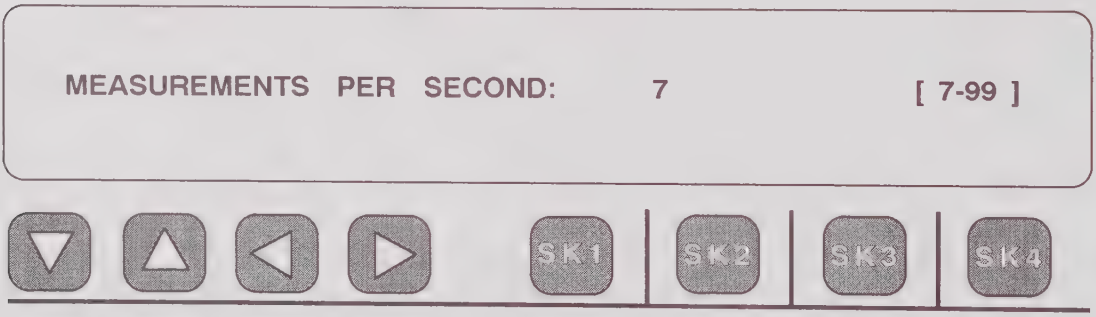
To choose a step size of 6dB instead of the 4 dB value, press Softkey 2 (under **6 dB**) and the 930A display will change to:


THRESH: 58 dBrnC SPRD: 6 dB 7 M/S MORE

The Spread is now 6 dB and the counter thresholds will now be set at 58 dBrnC, 64 dBrnC, and 70 dBrnC.

To change the number of measurements per second which the 930A makes, press Softkey 3 (under **7 M/S**). The standard value is 7 measurements per second but other common values are; 8 measurements per second, and what is called a "channel limited" measurement. To change the number of measurements per second, do the following:

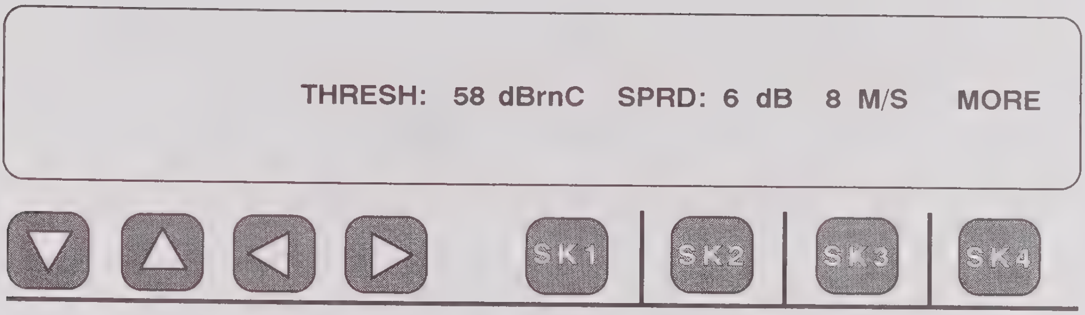
Press Softkey 3 and the 930A display will change to:


MEASUREMENTS PER SECOND: 7 [7-99]

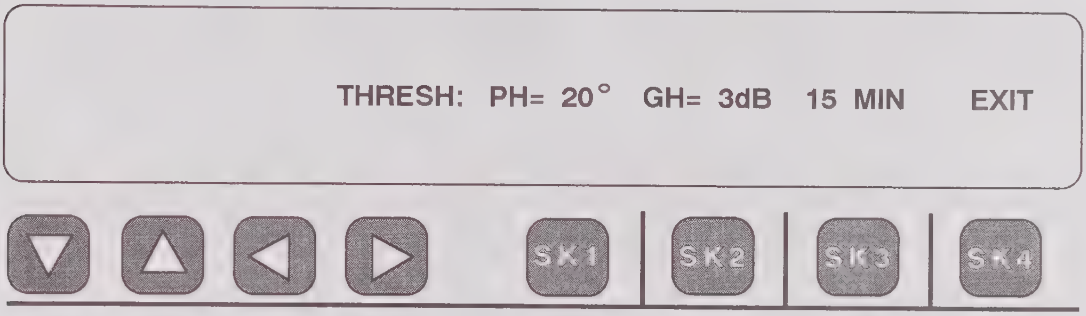
The acceptable values range from 7 measurements per second to 99 measurements per second. If you want to set in a value of 8 measurements per second, for example, then do the following:

Press 8 and then ENT

The 930A display will change to the one shown on the following page.



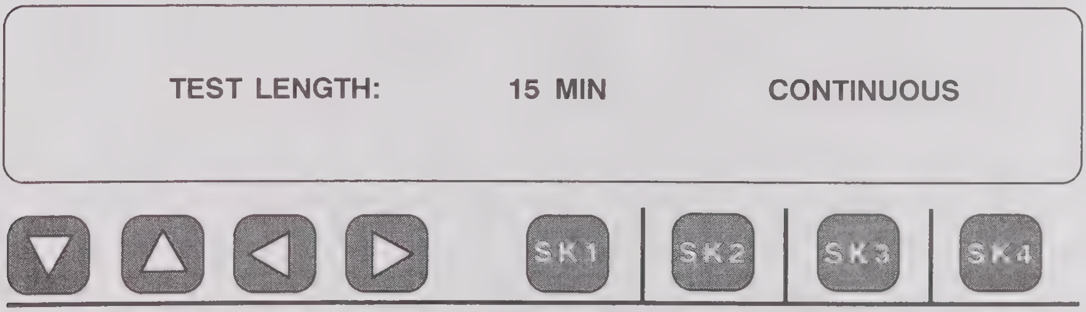
To change the measurement time period, press Softkey 4 (under **MORE**) and the 930A display will show:



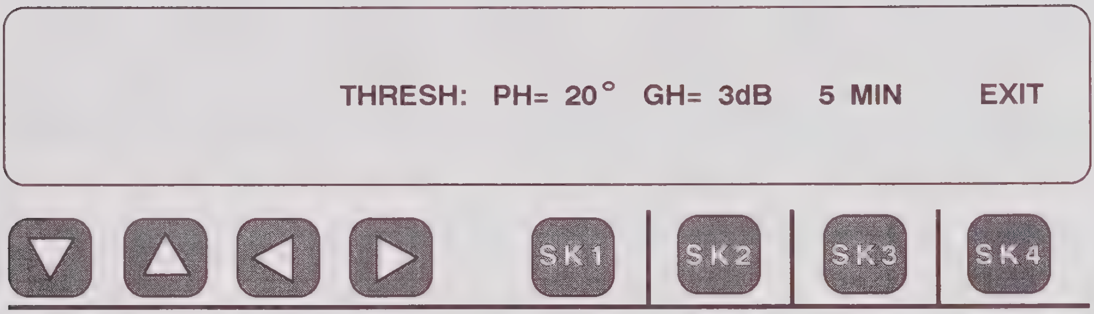
The Phase and Gain Hit Thresholds are discussed in Section 4-8.2 and so we go directly to the measurement interval.

The standard value used is 15 minutes, however, the Model 930A can make timed measurements of Impulse Noise from 1 minute duration to 99 minutes duration or it can be set to continuously measure.

Suppose you want a 5 minute test length. Press Softkey 3 (under **15 MIN**) and the 930A display becomes:

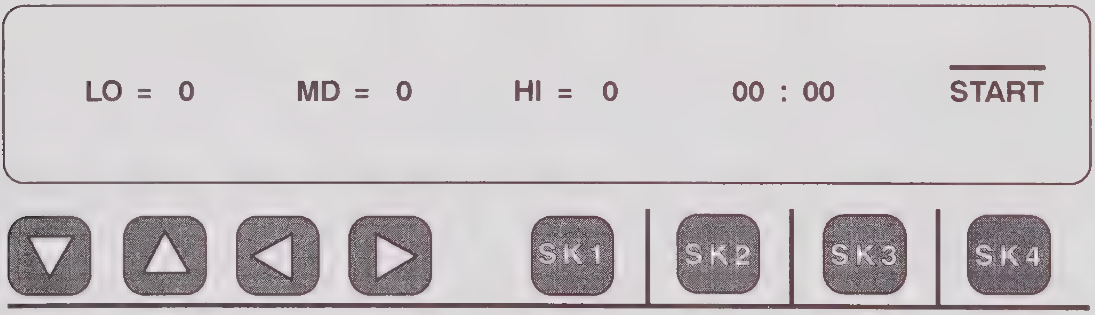


Press 5 and then ENT
and the 930A display changes to:



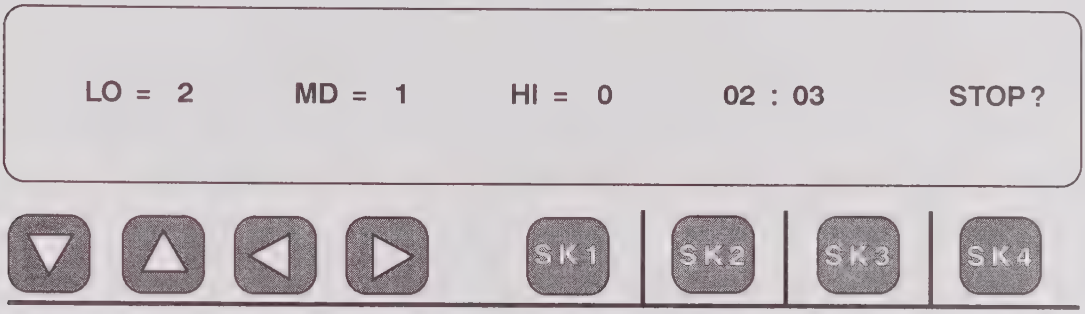
All of the Impulse Noise measurement parameters have now been changed. You are free to select other values within the acceptable ranges given for each parameter. This example was intended only to show the method.

When you have set-up the Model 930A, press Softkey 4 (under **EXIT**) in the above display. The 930A will go to the measurement display shown below:



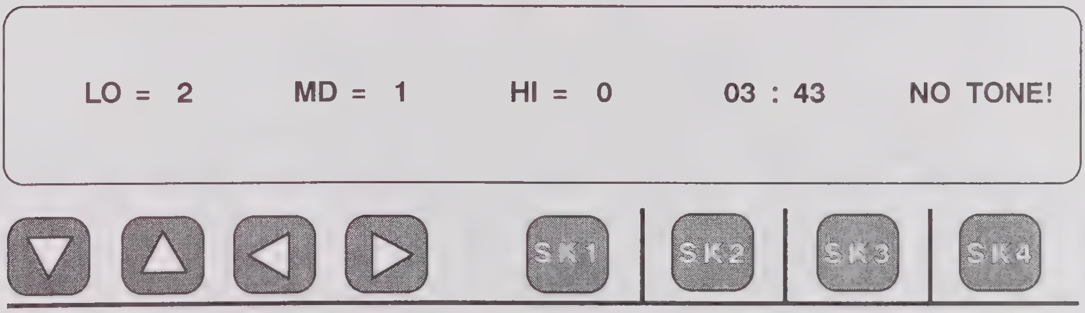
Pressing Softkey 4 (under **START**) begins the measurements.

After some time has elapsed (remember that this example has set a 5 minute measurement time), a typical display might appear as:



This display shows that after 2 minutes and 3 seconds of testing, there have been 2 impulse noise bursts that have exceeded the 58 dBrnC threshold, 1 that has exceeded the 64 dBrnC threshold, and none that has exceeded the 70 dBrnC threshold. This test would continue until 5 minutes had elapsed and then stop (time was set to 5 minutes in this example). You can stop the test at any time by pressing the **OPTION MENU** function key. The impulse counters have maximum values of 9999 impulses.

If the test is to be performed with holding tone over a loopback circuit, the 930A should be set to send 1004 Hz at -13.0 dBm using the **SEND TONE** function. The words **"NO TONE!"** will appear above Softkey 4 if the holding tone drops below -40.0 dBm at any time during the test, as shown below:



The default value of low threshold used by the 930A is 54 dBrnC0 which is the setting for voice frequency metallic cable facilities less than 500 miles in length. This threshold assumes the use of a -13 dBm0 holding tone.

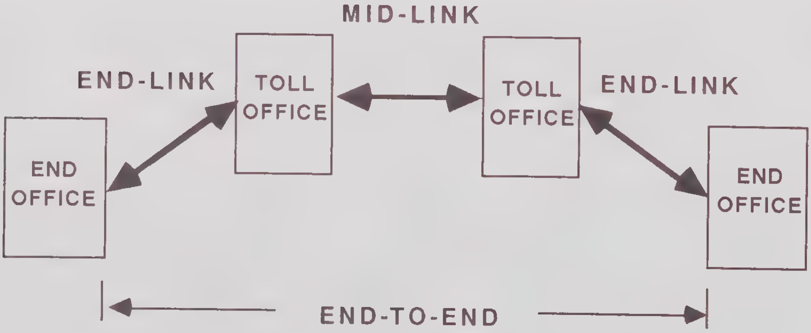
If you have selected the **PCM or T-1 Carrier** trunk interface, then the 930A will select 67 dBrnC0 as its low threshold when **DEFAULT** is pressed. This is the correct low threshold on T-Carrier circuits.

Other commonly used low thresholds are: **59 dBrnC0 for PBX tie trunks** and **67 dBrnC0 for mixed metallic and T-1 carrier facilities** less than 500 miles long. So, even though the measurement may be made on the metallic end of a circuit, you must change the low threshold to 67 dBrnC if any part of the end-to-end circuit goes over T-1 carrier facility.

The maximum impulse counts allowed, without exceeding maintenance guidelines over a 15 minute period, relate to the threshold and step size. These may vary from one operating company to another. The following values come from the pre-divestiture days and are:

Threshold	< 15 counts
Threshold + 4 dB	< 9 counts
Threshold + 8 dB	< 5 counts

The overall end-to-end low threshold at the customer premises is usually 71 dBrnC0. The end-link low threshold alone is usually 67 dBrnC0. The mid- link low thresholds are based on mileage, and range from 54 to 73 dBrnC0. The diagram below explains the terminology of end-links and mid-links.



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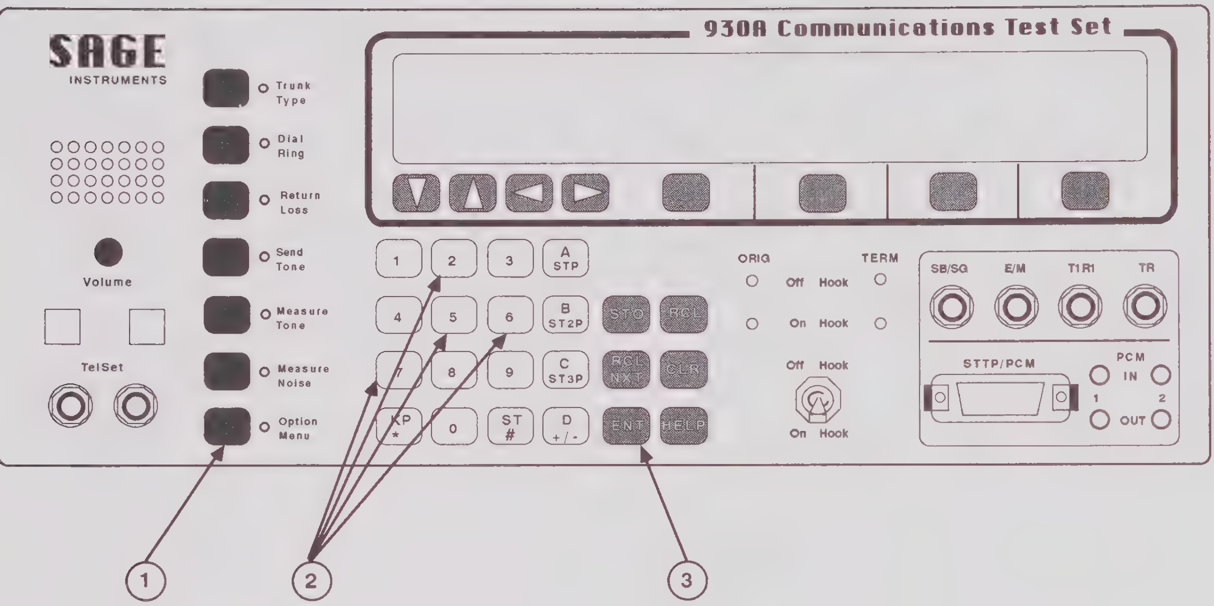


To select the **ROTL/RESPONDER/INTERROGATOR** Menu Options:

1. Press the **OPTION MENU** function key.
2. Use the numeric keypad to enter:
   25 for the **105 FAR END RESPONDER,**
   26 for the **ROTL/NEAR END RESPONDER,** or
   27 for the **ROTL INTERROGATOR**
3. Press the **ENTER** key to complete entry and selection.
4. Refer to Section 4-6 for further information.

ROTL/RESPONDER/INTERROGATOR
FIGURE 4-5

4-6 ROTL/RESPONDER/INTERROGATOR (OPTION 930A-12)

The Model 930A, when equipped with Option 930A-12, provides a test capability similar to the Centralized Automated Routining Of Trunks (**CAROT** or 52A) system in manual or remote control applications. The functions of a **Remote Office Test Line (ROTL)/Near End Responder**, **Far End Responder**, and **ROTL Interrogator** are contained under **Menu Options 25, 26 and 27**. These features are compatible with **AT&T Type 105 test lines. You can measure** 1004 Hz loss, noise, noise with tone, gain/slope, ERL, SRL-LO, and SRL-HI.

In addition, if you are testing toward a SAGE Model 356E Far End Responder, or another 930A equipped with Option 930A-12 and version 3.21 or above software, you can do the extended range of tests. These tests include: Signal-to-Noise, Attenuation Distortion, 3 KHz Flat Noise, P/AR, Intermodulation Distortion, Phase/Amplitude Jitter, Envelope Delay Distortion, Impulse Noise and Hits.

With Option 930A-10C, you can connect a printer to the 930A to obtain a hard copy of the test results.

4-6.1 USING THE 930A AS A TYPE 105 FAR END RESPONDER (MENU OPTION 25)

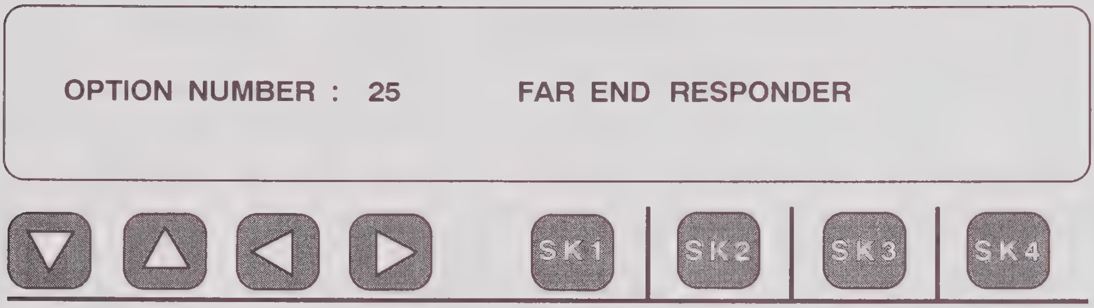
With Option 930A-12, you can configure the 930A as a Type 105 Far End Responder. The 930A can then be controlled by any CAROT compatible ROTL. You can measure Loss, Noise, Noise with Tone, Gain/Slope, and Return Loss. The 930A can be accessed over any of it's analog interfaces, or it can provide this function directly on a T-1 PCM channel.

Before testing, set up the **Trunk Type** (Refer to Section 3-4) and connect the 930A to the circuit. Once this has been accomplis ed, perform the following steps to place the 930A in Far End Responder mode:

Press the Option Menu key.

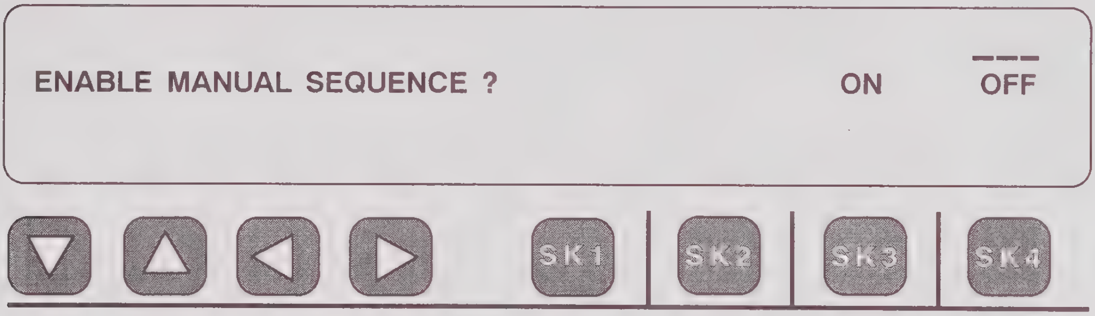
Use the UP/DOWN arrow keys

to select Menu Option 25: FAR END RESPONDER.



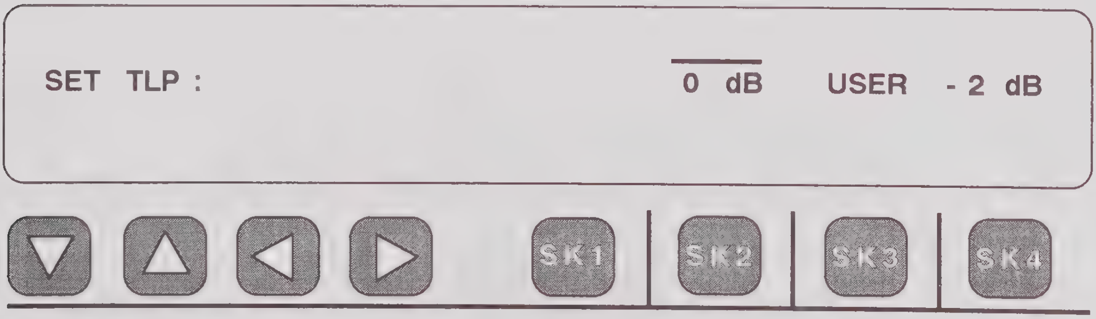
OPTION NUMBER : 25 FAR END RESPONDER

Press any softkey under the display and the 930A will ask the question:



ENABLE MANUAL SEQUENCE ? ON OFF

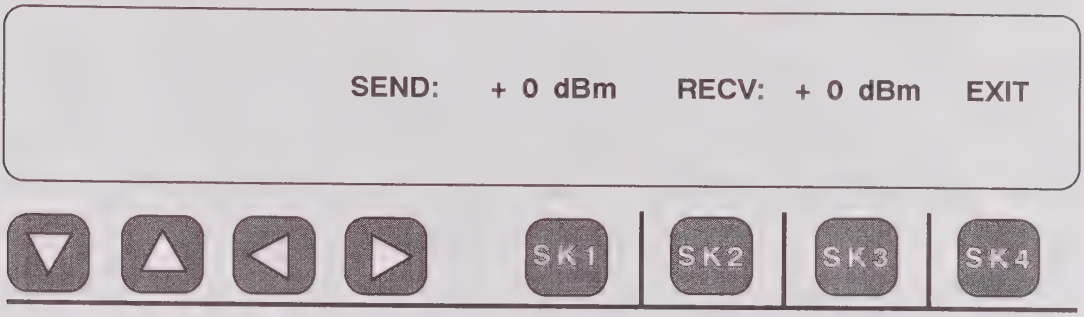
The Manual Sequence is normally **OFF**. You would press Softkey 4 (under **OFF**) and continue on with the **SET-UP**. The Model 930A always functions in the automatic sequence mode. The manual sequence just provides a means for performing single direction tests and is most useful for PBX testing. **If you want the manual sequence**, press Softkey 3 (under **ON**). In either case, the 930A will prompt you to set the **TLP** as shown below:



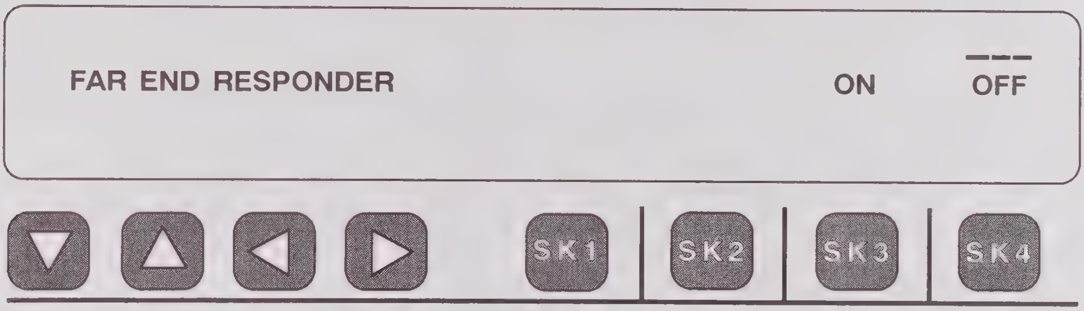
SET TLP : 0 dB USER - 2 dB

Press Softkey 2 to select 0 dB or **Softkey 4** to select -2 dB **TLP**. If -2 dB is selected, the 930A inserts a 2 dB pad into its input and output paths. **Press Softkey 3** under USER if you need to set a Send or Receive TLP value other than the standard 0 dB or -2 dB values.

If you press Softkey 3 under USER, then the display will change to:



To change the SEND TLP, press Softkey 1 and then enter the desired TLP using the keypad. Press ENTER to complete the selection. **To change the RECEIVE TLP,** press Softkey 3 and enter the desired TLP from the keypad. Press ENTER to complete the selection. When you have finished, press Softkey 4 to EXIT and the display changes to:



You turn on the **far end responder by pressing Softkey 3.** A cursor will appear over the **ON** indication. The 930A is now acting as a Type 105 Responder waiting to be accessed. The above display appears regardless of whether or not you choose the manual sequence. In either case, pressing Softkey 3 is necessary to enable the responder function.

When accessed by ringing, or far-end seizure, the 930A goes off hook and responds with a 2225 Hz test progress tone (**TPT**). The 930A then waits for **MF** commands and performs the corresponding Type 105 tests. The 930A will continue in this mode until:

a. It is released by the calling party via an MF "release" command.
b. The calling party goes "**On Hook**" (See Note).
c. No **MF** command is received for 20 seconds (930A defaults to Manual mode if selected).

d. The operator presses the "**OFF**" softkey, or any Function key on the 930A front panel.

When the 930A is released, or the calling party goes **On Hook**, the 930A goes On Hook for 1 second and then awaits seizure or ringing. If the 930A is allowed to time out (20 seconds without an **MF** command), it will either go **On Hook**, or initiate the manual test sequence (if selected).

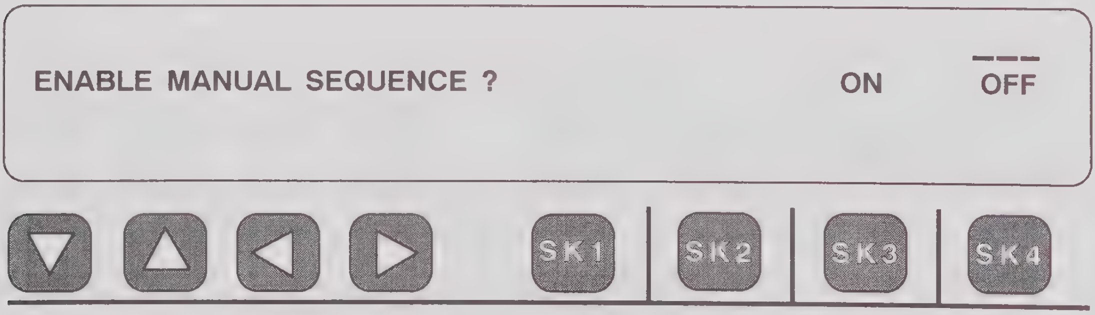
NOTE: If the 930A is on a **LOOP** trunk, simulating the subscriber (providing **CONTACT** rather than **BATTERY**), it will expect the far end to remain **On-Hook**, and will not treat this as a release condition.

For **PBX** testing, the manual mode sequence is most useful. If the Manual mode has been selected, the responder is allowed to time out (no **MF** command is sent) for 20 seconds or more. The Model 930A then provides the manual trunk test tone sequence shown below:

1. 9 seconds of 1004 Hz tone at -16 dBm0
2. 1 second of quiet termination
3. 9 seconds of 404 Hz tone at -16 dBm0
4. 1 second of quiet termination
5. 9 seconds of 2804 Hz tone at -16 dBm0
6. 30 seconds of quiet termination
7. Short burst of TPT (2225 Hz) signaling end of sequence
8. On-hook

If the manual test sequence is not enabled, the 930A will return to the **On Hook** state after a 20 second time out.

NOTE: To initiate manual testing, you must enable the Manual Sequence when the 930A display asks for the choice. That display is repeated below and shows **OFF** as the previous condition.

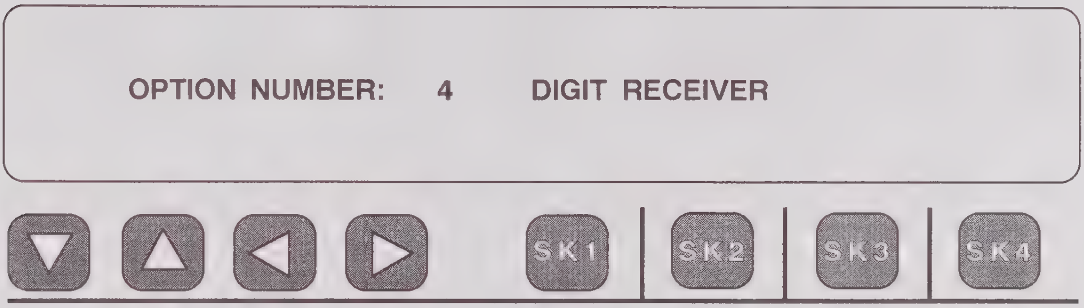


ENABLE MANUAL SEQUENCE ? **ON** **OFF**

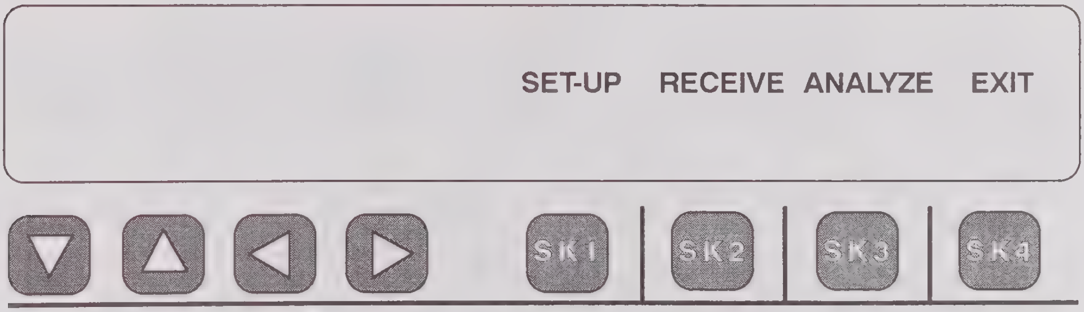
Press Softkey 3 to enable the Manual Sequence. **Press Softkey 4** if you do not want it.

4-6.1.1 RESPONDER TESTING USING THE DIGIT RECEIVER (OPTION MENU 4)

With Option 930A-12 and Option 930A-01: **Digit Receiver/Analyzer**, you can set the 930A to be a **Type 100**, **102**, or **105 Test Line** after a call sequence has been received. After you have set the 930A to the correct **TRUNK TYPE** (Refer to Section 3-4), you can proceed to the Digit Receiver. **Starting from Menu Option 4** below:



Press any softkey under the display and the main menu will appear:

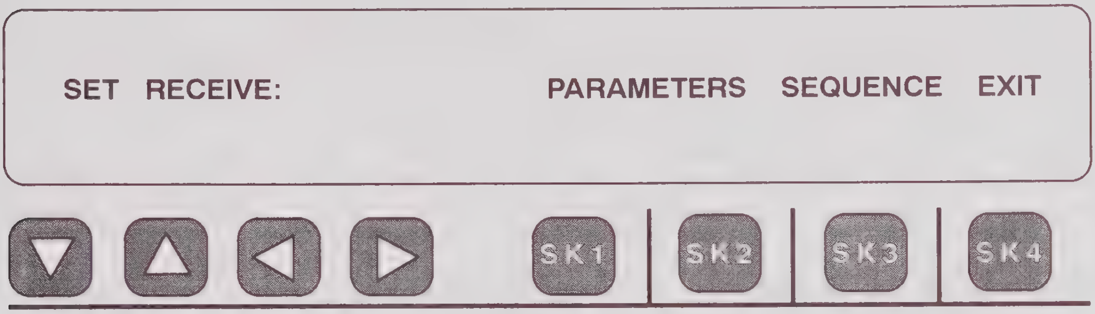


NOTE: To set a TLP other than the default value of 0 dB you must first set the TLP in Menu Option 25 before you set up the Digit Receiver to act as a far end responder.

Remember, you have to set the Digit Receiver up for the expected call and it's parameters. Section 4-2 gives the details. For our purposes, an example will serve to illustrate the procedure for all cases.

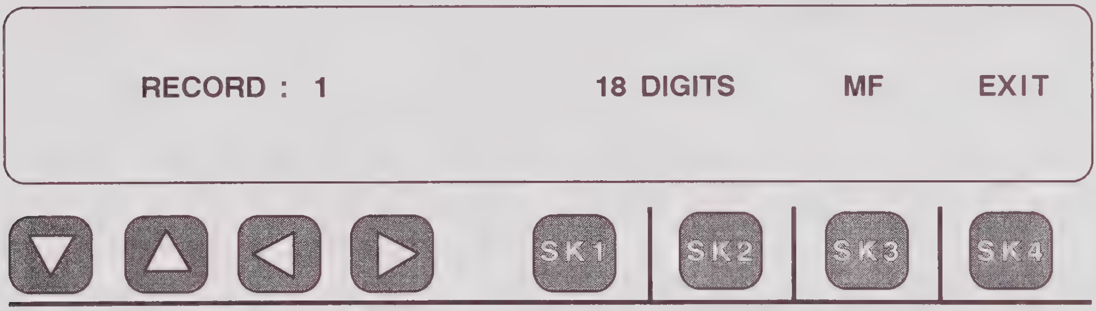
For this example, we want the 930A to be a Type 105 Far End Responder after it receives a Touch-Tone (**DTMF**) call on a Wink Start Trunk.

First, a single **DTMF** sequence on a Wink Start Trunk is expected. Press Softkey 1 (under **SET-UP**) in the previous display and the **SET-UP** menu will be displayed:



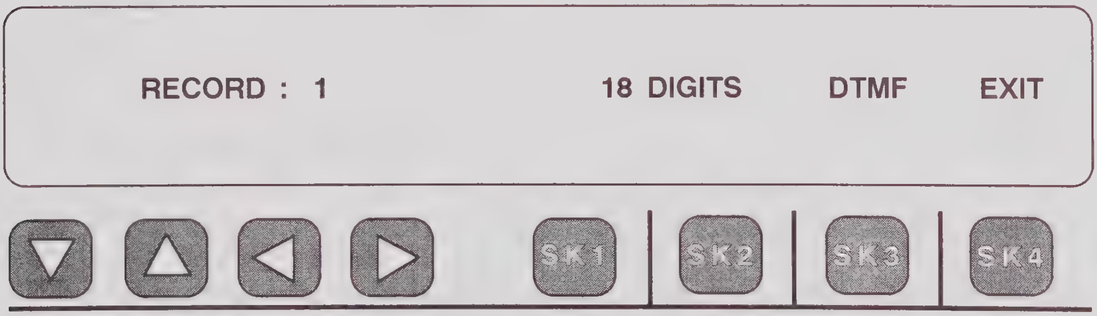
SET RECEIVE: PARAMETERS SEQUENCE EXIT

Press Softkey 1 (now under **PARAMETERS**). The display will show the previously entered settings. The 930A default display is shown for example:



RECORD : 1 18 DIGITS MF EXIT

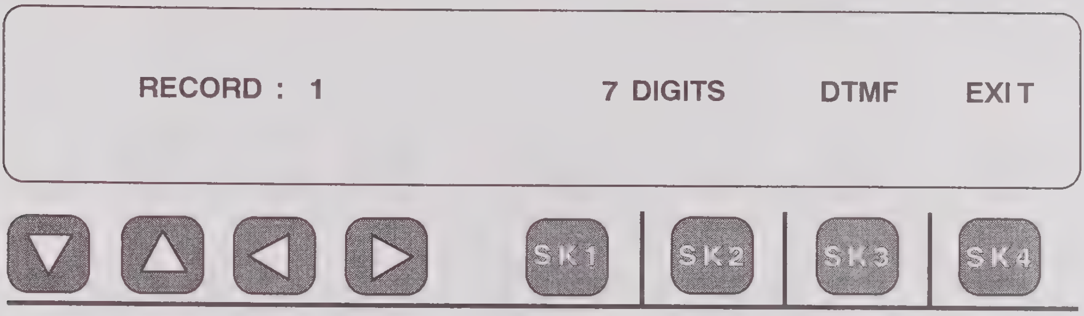
The parameters above must be changed to **DTMF** digits of the correct length. Press Softkey 3 (under **MF**) until **DTMF** appears as shown below:



RECORD : 1 18 DIGITS DTMF EXIT

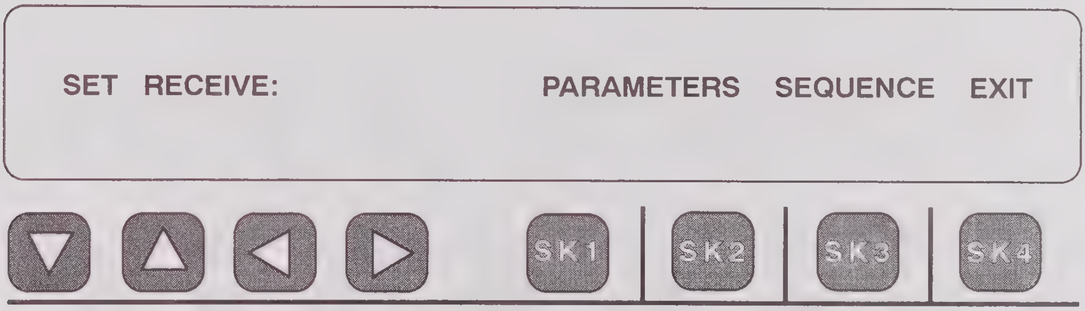
Next, since this is a **DTMF** sequence, the correct length of the expected call must be entered or the 930A will wait for digits that will never come. A local call of 7 digits (no area code) length will do.

Press 7 and then the ENTER key and the display will read:

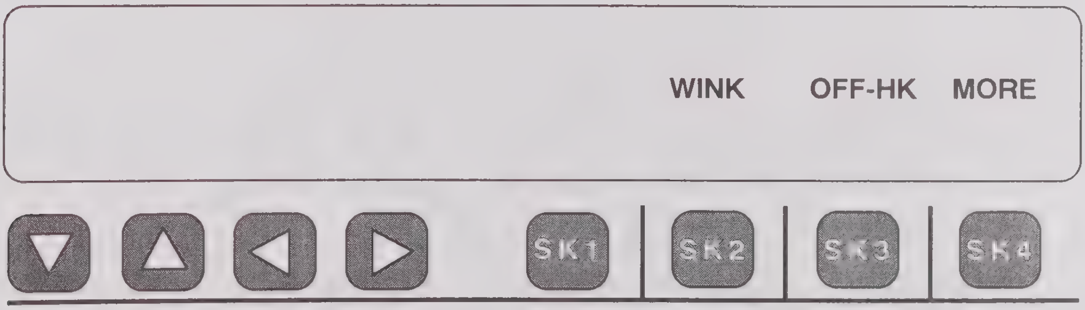


Since only a single record is expected (this is not a Multi-Wink example), there is no need to set up records 2, 3, or 4.

Press Softkey 4 (under **EXIT**) and the main **SET-UP** menu reappears:

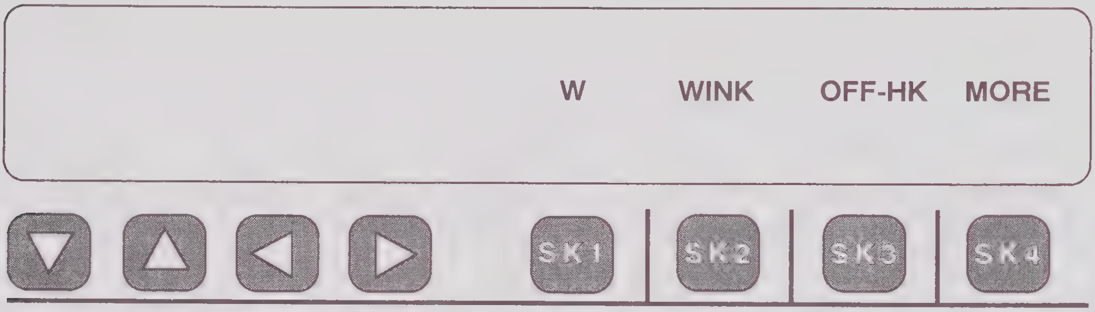


Now you must enter the correct call sequence. To do this, press Softkey 3 (under **SEQUENCE** above) and the 930A display will become:

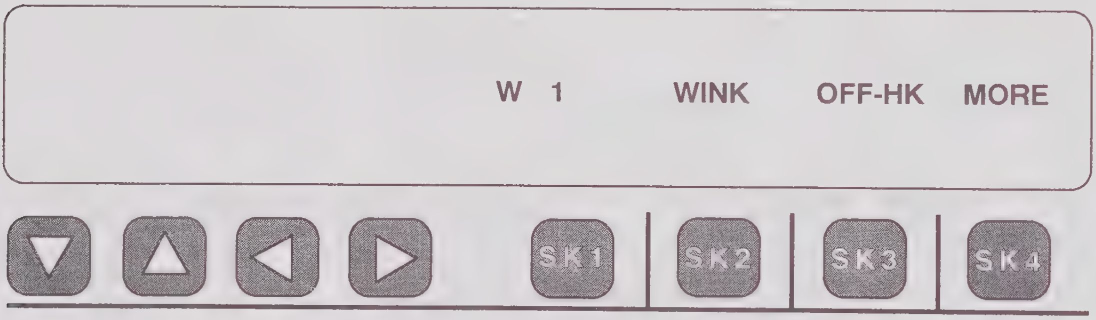


If there is a previously entered sequence present, press the **CLEAR** key to obtain the above display. Remember that, for this example, a Wink Start trunk was specified. This means we have to tell the 930A to provide the Wink, since it is acting as the receiver.

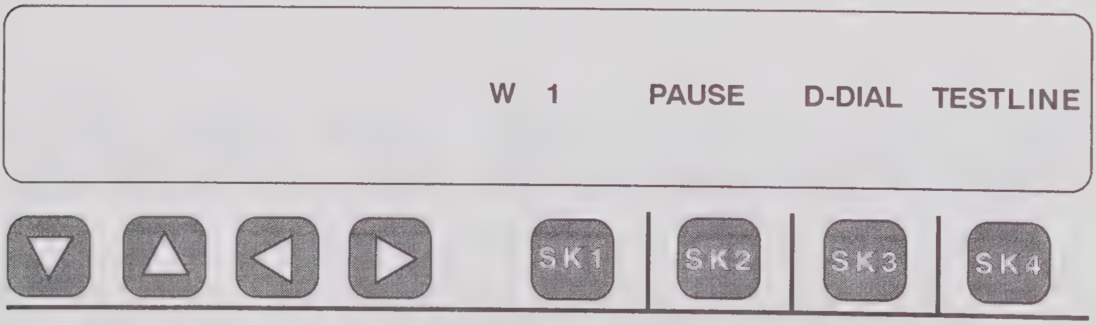
To enter a **Wink** into the sequence, press Softkey 2 (under **WINK**) and the display will become:

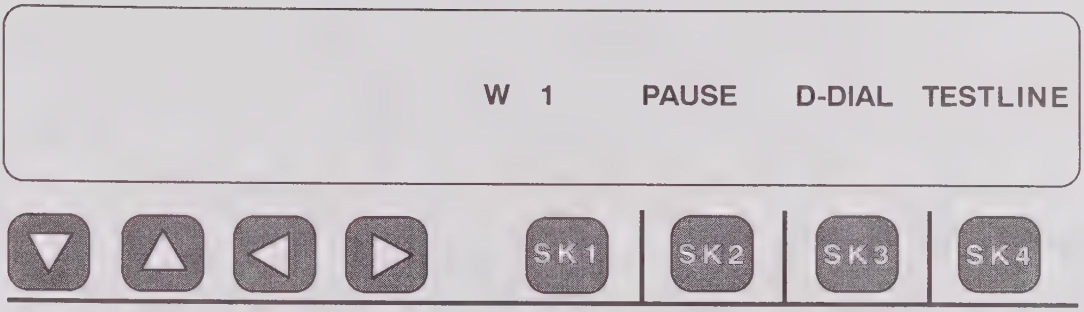


After it gives the Wink, the 930A has to be told to receive one record, or called number. To do this, enter the number "**1**" into the sequence. Press "**1**" on the numeric keypad, then press **ENTER**, and the display becomes:

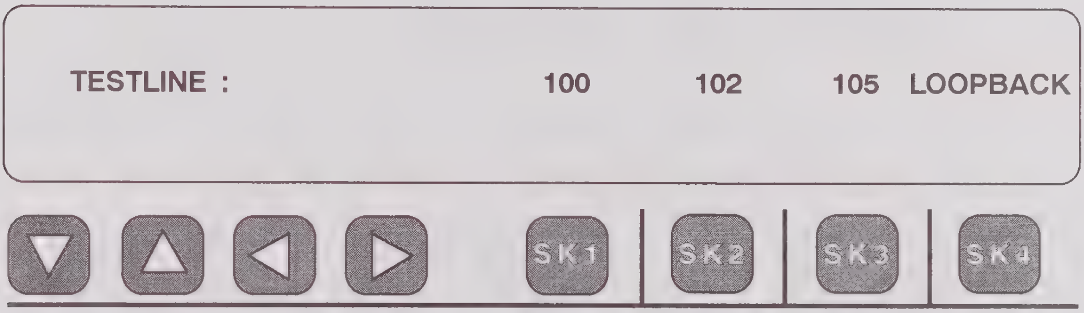


At this point, we have the simple Wink Start set-up from the example in Section 4-2. You will now find out what is under the softkey labeled **MORE**. We want the 930A to become a Type 105 Test Line after it receives the call. To do this, press Softkey 4 (under **MORE**) and the 930A display becomes:

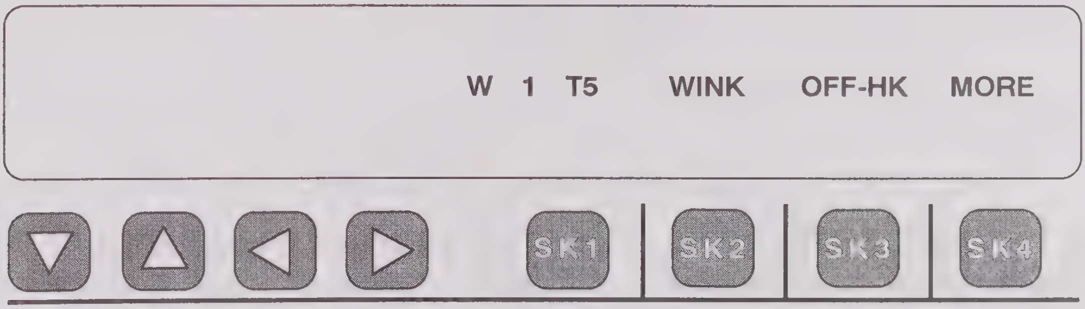




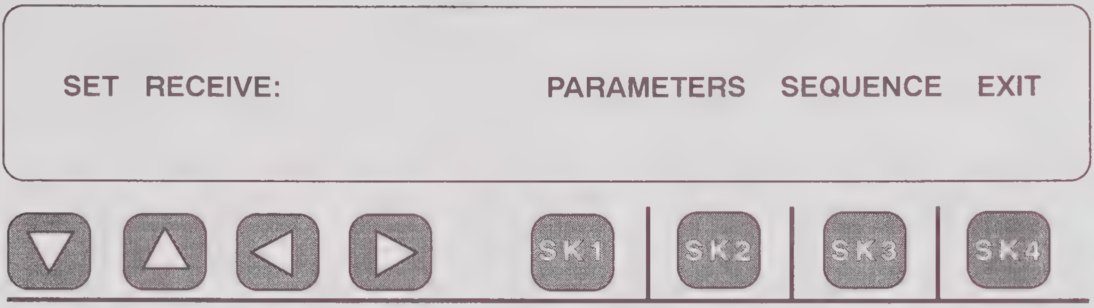
Press Softkey 4 (under **TESTLINE**) and the 930A display will show the choices:



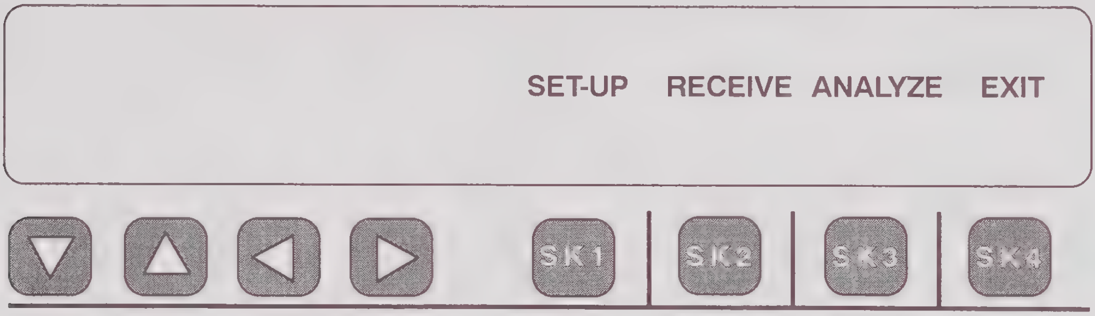
To emulate a Type 105 Responder at the end of the received sequence, press Softkey 3 (under **105**) and the 930A display will show:



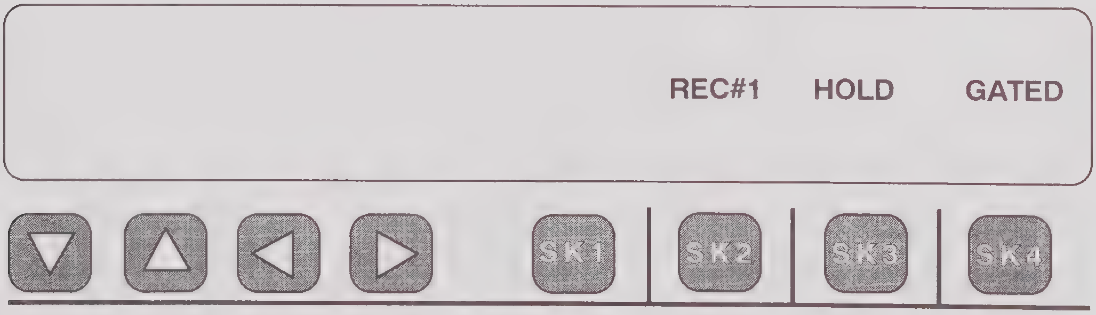
The proper sequence has now been set up. **The last step** is to place the 930A in the **RECEIVE** mode. Press the **OPTION MENU** key to return to the **SET-UP** menu shown on the following page.



Press Softkey 4 (under **EXIT**), or the **OPTION MENU** key, to return to the main menu:



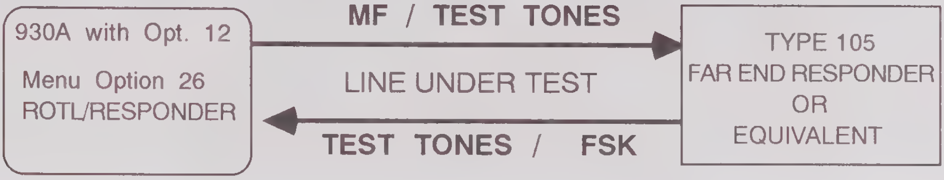
Press Softkey 2 (under **RECEIVE**) to select the Digit Receiver mode of operation. The 930A display will appear as shown below:



When the 930A sees a seizure of the trunk it will respond with a Wink. Then it will expect to receive a digit string (**DTMF** digits in this example) which will be displayed across the screen. After the digit string has been received the 930A will emulate a Type 105 Test Line until the distant end goes back **On Hook**.

4-6.2 USING THE 930A AS A ROTL/NEAR-END RESPONDER (MENU OPTION 26)

With Option 930A-12, the Model 930A can also perform the functions of a **ROTL/Near-End Responder**. The 930A can access a 105 far-end responder and supply the **MF** signaling necessary to initiate Loss, Gain/Slope, C-message Noise, Noise with Tone, and Return Loss measurements. A typical connection is shown below:



The 930A can also access a SAGE Model 356E Far End Responder or another 930A and do the extended range of tests listed on page 4-77.

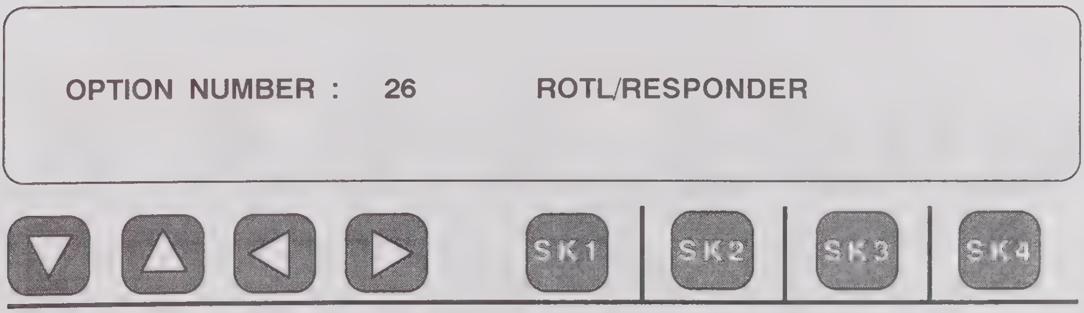
To set the Model 930A up as a ROTL/Near-End Responder, do the following:

Press the Option Menu key.

Use the UP/DOWN arrow keys

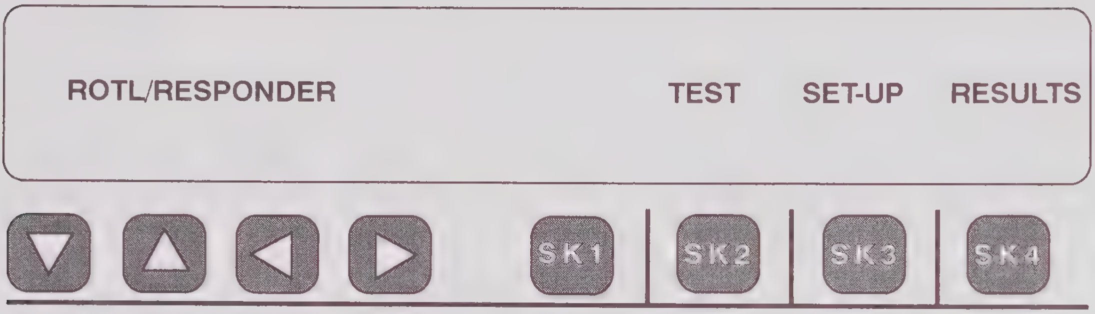
to select Menu Option 26: ROTL/RESPONDER.

The 930A display will appear as:

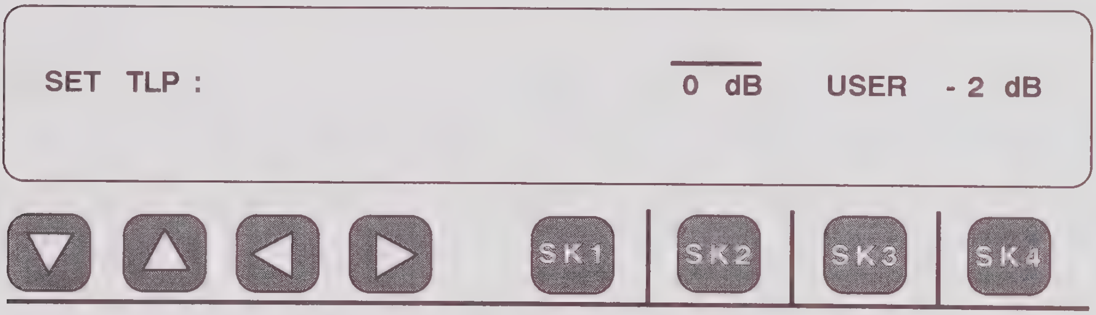


```
OPTION NUMBER :   26        ROTL/RESPONDER
```

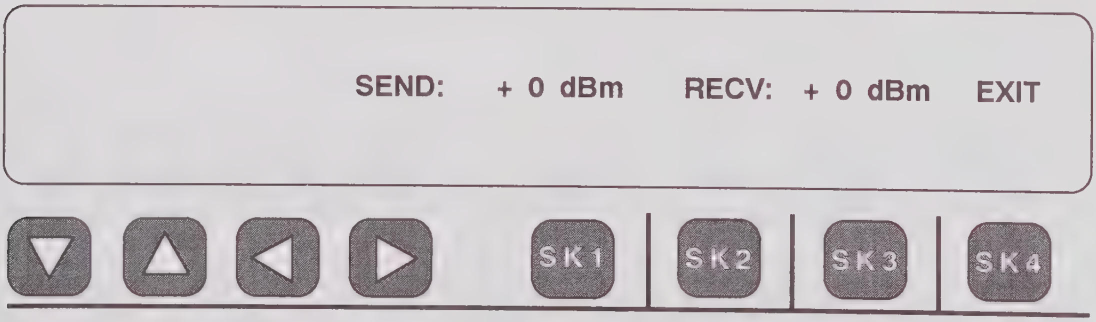
Press any softkey under the display and the main menu will appear:



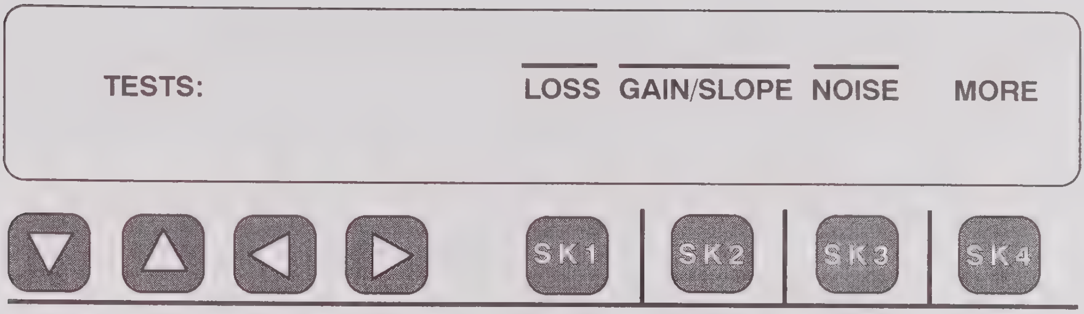
To begin, press Softkey 3 (under **SET-UP**). The 930A display changes to:



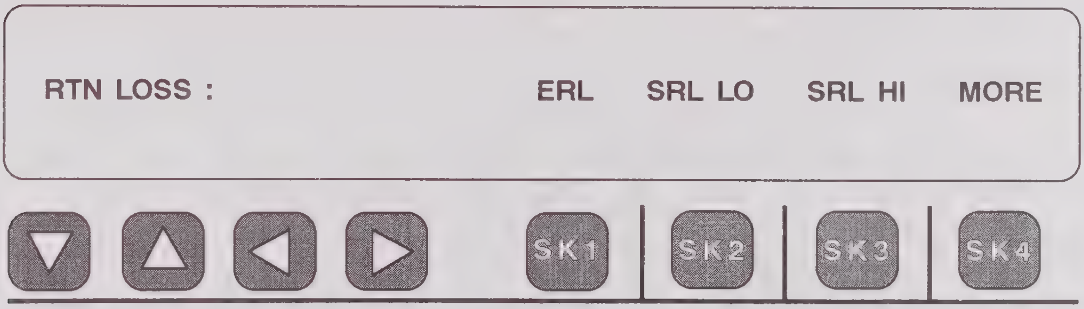
Press Softkey 2 if the set is connected at a 0 dB point, or **Softkey 4** if the set is connected at a -2 dB point. **Press Softkey 3 under USER,** if you wish to set Send or Receive TLP values other than 0 or -2 dB. The 930A display will then change to:



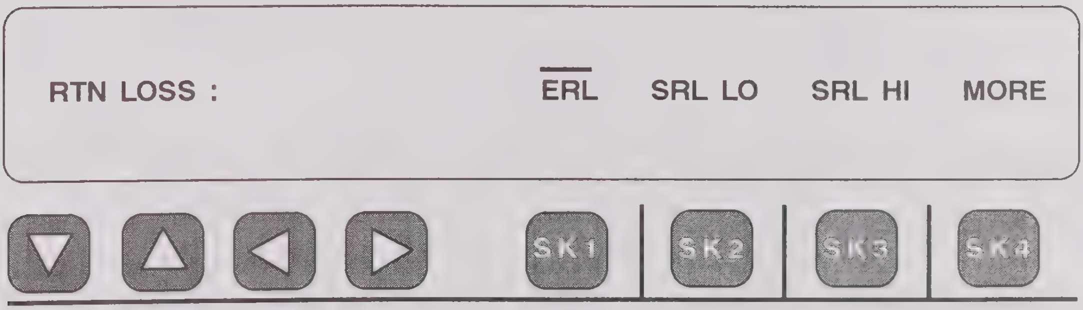
Press Softkey 1 to change the **SEND TLP**. The range is +7 dB to -25 dB. Use the keypad to enter your choice and press **ENTER** to complete the selection. **Press Softkey 3** to change the **RECEIVE TLP**. The range is + 7 dB to -16 dB. Use the keypad to enter your selection and then press **ENTER**. When you have finished press Softkey 4 under **EXIT** and the next display will appear.



Tests which have been selected are highlighted, as are all of the above tests. To select or de-select a test, press the softkey directly beneath the test. This will toggle between select and de-select. Pressing Softkey 4 (under **MORE**) will cause the 930A to display the next series of tests which are:



You can select any, or all, of the return loss measurements by pressing their associated softkeys. For example, if you want to do the Echo Return Loss measurement, press Softkey 1 (under **ERL**) and a cursor will appear over **ERL** on the 930A display as shown below:



You may also select **SRL-LO** and/or **SRL-HI**. **Return Loss testing** is not standard in all far-end responders. If you get a far-end "**failed**" response from the 930A, you will know the far-end does not have Return Loss capability. Press the **OPTION MENU** key to return to the main menu and begin testing toward standard responders. If you are testing toward a SAGE Model 356E Far End Responder or another 930A, you may press Softkey 4 under **MORE** to select additional tests.

The standard code 105 transmission tests which can be performed by the 930A are briefly described below:

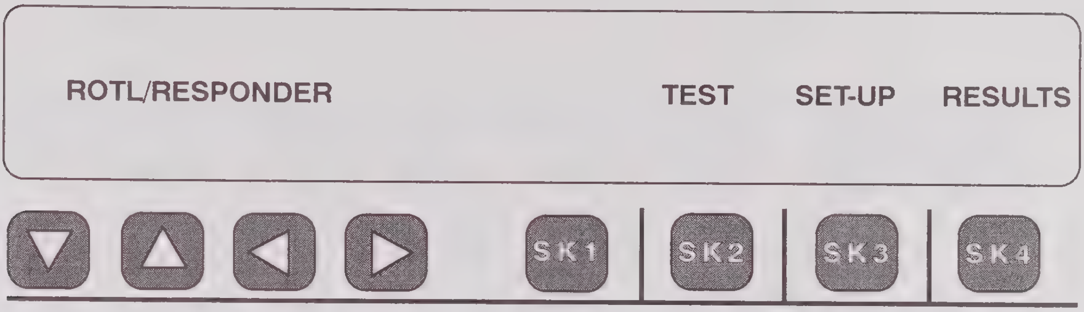
1. **LOSS** tests the two-way loss at 1004 Hz, 0 dBm.
2. **GAIN/SLOPE** tests the two-way loss at 404 Hz, 1004 Hz, and 2804 Hz. All tone levels are at -16 dBm.
3. **NOISE** tests **C-Message** noise in both directions and tests two-way **C-Notch** noise using a -16 dBm, 1004 Hz holding tone.
4. **ERL, SRL-LO and SRL-HI** tests the two-way **return loss** for each of the three types.

The enhanced responder transmission tests also include the following:

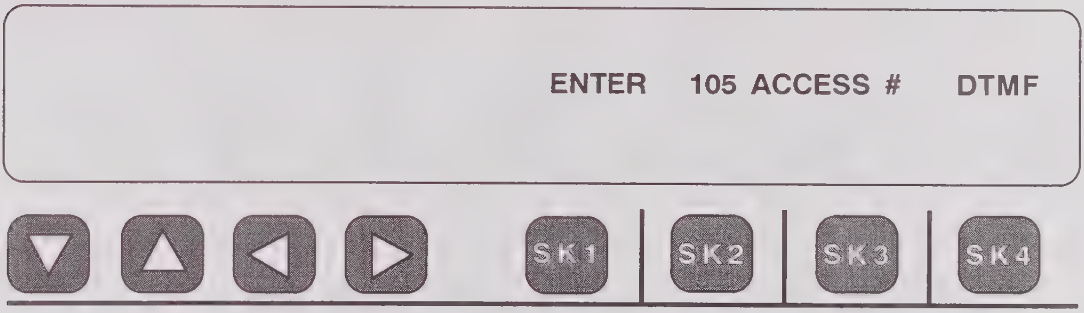
5. **FREQ SWP** tests two-way attenuation distortion.
6. **S/N** tests two-way signal-to-noise ratio.
7. **3K FLAT** tests 3 KHz flat-weighted noise in both directions.
8. **P/AR** tests Peak-To-Average ratio in both directions.
9. **INTERMOD** tests two-way 4-Tone Intermodulation Distortion.
10. **JIT HI** tests phase and amplitude jitter in 20-300 Hz band in both directions.
11. **JIT LO** tests phase and amplitude jitter in 4-300 Hz band in both directions.
12. **EDD** tests Forward and Return Reference Envelope Delay.
13. **IMP/HITS** tests three-level Impulse Noise, Phase Hits, Gain Hits, and Dropouts in both directions. Test length and other parameters are user selectable.

Once you select the tests you want, the set-up phase of the test procedure is finished. This need not be repeated unless the **TLP** changes, or different tests are wanted.

Press the OPTION MENU key, or Softkey 4 under EXIT, to get back to the main menu and the 930A display will return to:

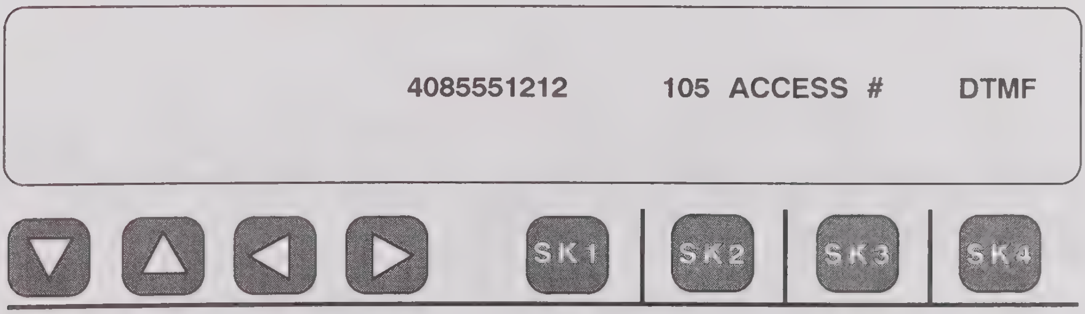


To begin the test procedure, press Softkey 2 (under **TEST**). The 930A display will change to the following:



The digit sequence may be **DP**, **MF** or **DTMF**. You select the appropriate type of signaling using Softkey 4. In the example above, **DTMF** outpulsing has been selected.

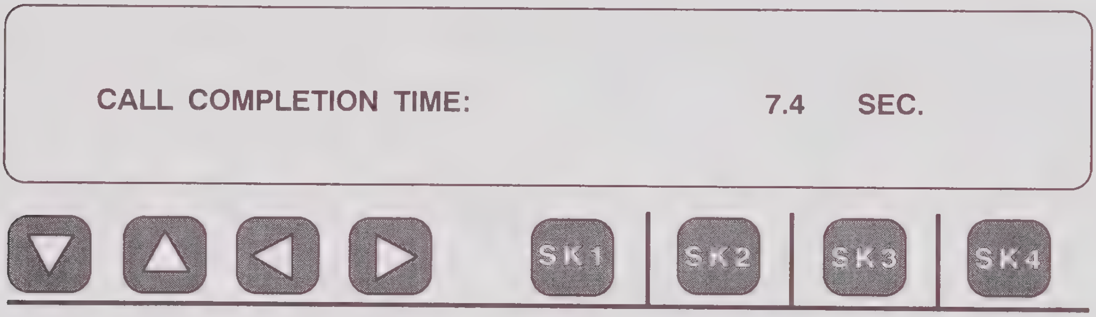
Now enter the phone number of the far end test line using the numeric keypad. An example of a **DTMF** phone number is shown below:



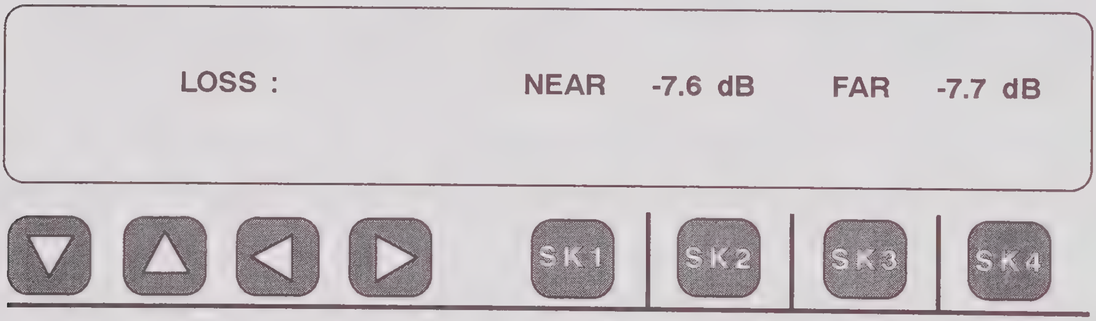
After you have entered the correct phone number, place the front panel hook switch in the **OFF HOOK** position to seize the line and send the call. When the far end has been accessed, you will hear a series of test progress tones as the 930A goes through the series of tests which were programmed.

For example, if you had selected only Loss, Noise and Noise with Tone, and Echo Return Loss measurements, the following series of displays would be shown on the 930A as it performed each measurement.

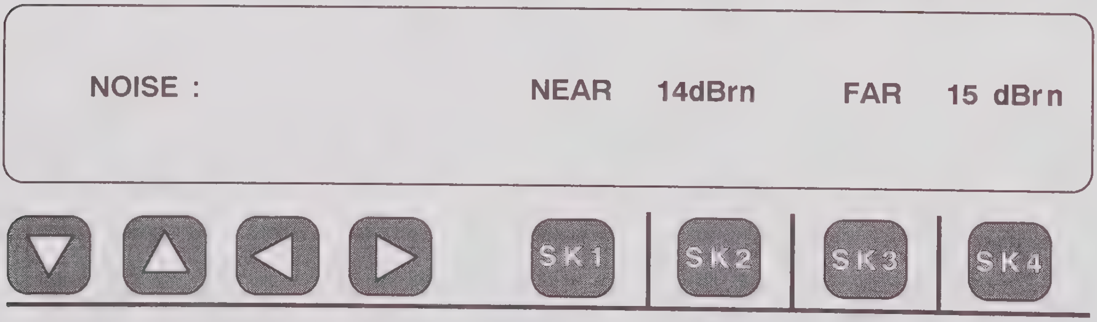
Notice that Call Completion time is measured first. For this example, typical displays might be:



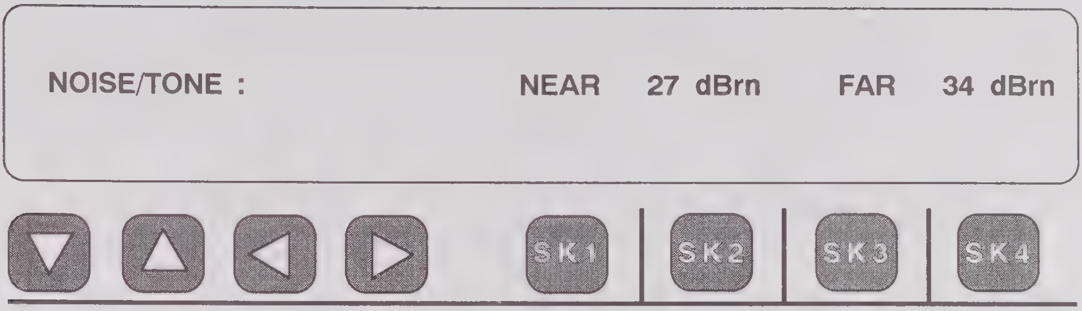
```
CALL COMPLETION TIME:                    7.4    SEC.
```



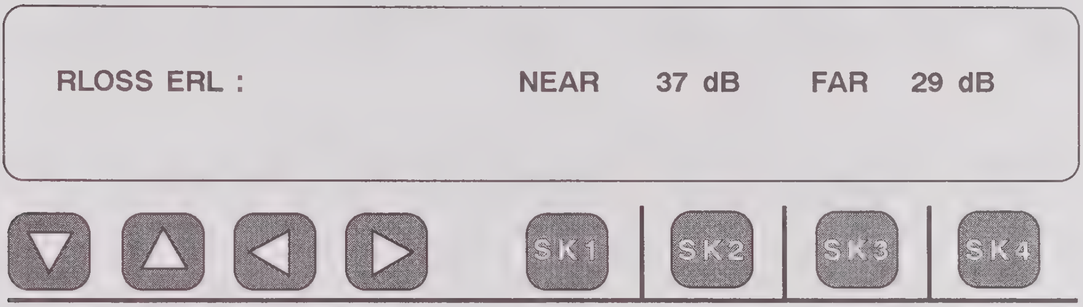
```
     LOSS :              NEAR   -7.6 dB      FAR   -7.7 dB
```



```
NOISE :                  NEAR    14dBrn      FAR    15 dBrn
```



NOISE/TONE : NEAR 27 dBrn FAR 34 dBrn

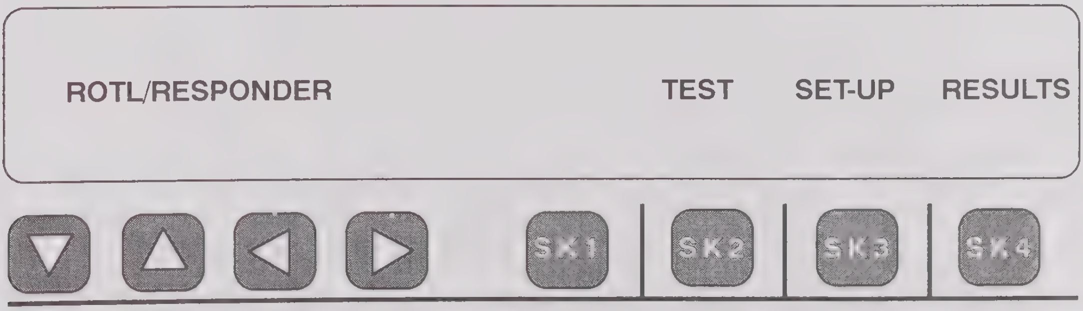


RLOSS ERL : NEAR 37 dB FAR 29 dB

The **NEAR** results equate to **Far-to-Near** results given by CAROT. Similarly the **FAR** results equate to the **Near-to-Far** results.

The 930A sequences through these tests and flashes the results briefly. The results are also stored in battery-backed **CMOS RAM**. If a printer is connected, the test results will be printed out as they occur. Once the sequence of tests has been completed the 930A releases the far-end responder.

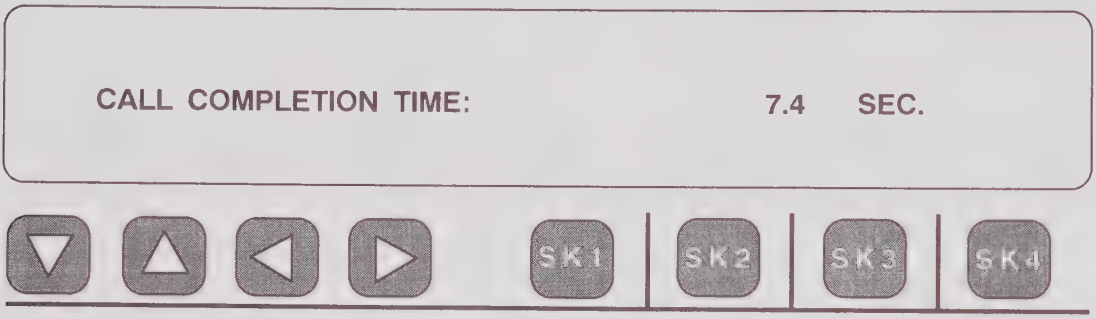
At the end, the 930A returns to the main display shown below:



ROTL/RESPONDER TEST SET-UP RESULTS

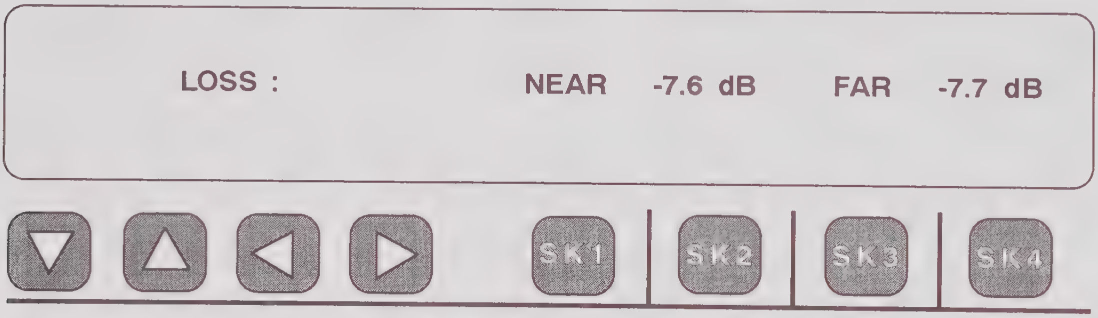
To view the results of the tests (which were flashed by at a reasonably rapid rate during testing), press Softkey 4 (under **RESULTS**). The 930A will recall the stored results of the previous test sequence.

In the previous example, after pressing Softkey 4, the **CALL COMPLETION** test results would have appeared as:



```
CALL COMPLETION TIME:                7.4    SEC.
```

You can then use the **UP/DOWN** arrow keys, or Softkey 1 to scroll through the various test results. For instance, pressing Softkey 1 would bring up:



```
LOSS :              NEAR   -7.6 dB     FAR   -7.7 dB
```

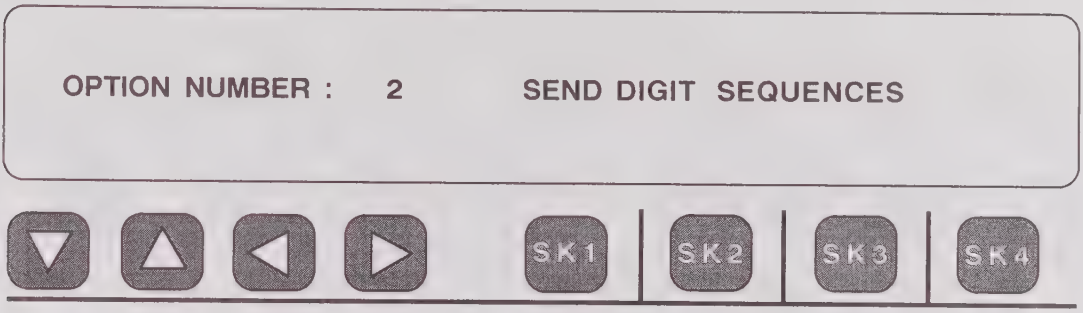
Continued pressing of Softkey 1, or the arrow keys, would enable you to review all of the test results in a convenient manner. The results are retained in memory until a new series of tests is begun and the old results are overwritten. **Press** the **Option Menu** key, or any front panel function key, to return to the main **ROTL/RESPONDER** menu display.

4-6.2.1 ROTL/RESPONDER TESTING USING SEND DIGIT SEQUENCES (MENU OPTION 2)

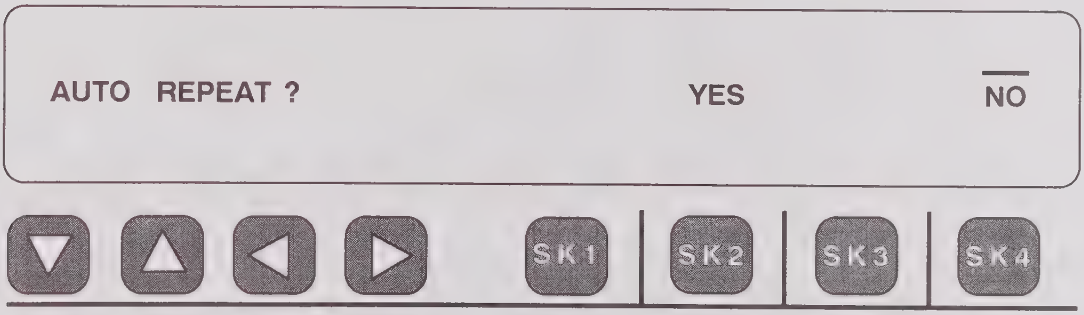
Option 930A-12 also enables you to operate the manual **ROTL** test function from **SEND DIGIT SEQUENCES,** Menu Option 2. This enables you to insert Winks or even place a Multi-Wink type call to initiate **ROTL** testing.

First, set up the **ROTL/RESPONDER** in Menu Option 26 as described in Section 4-6.2. **This selects the TLP and tests** which are desired. When this has been accomplished, you have the choice of sending the Far End

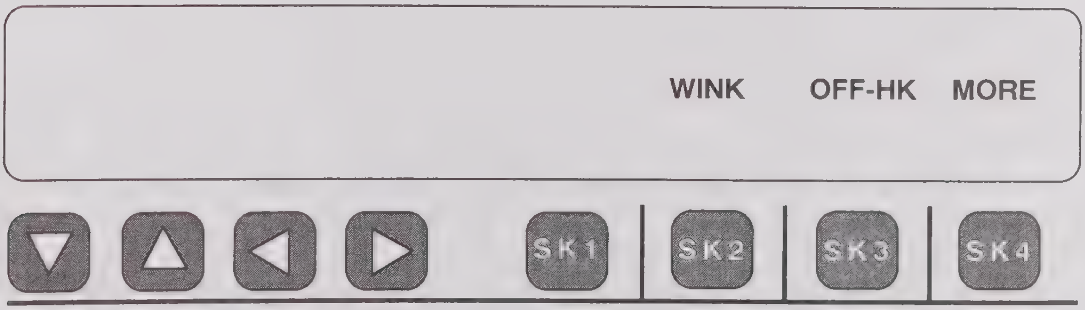
Responder's number from the **ROTL/RESPONDER** (Menu Option 26) or going to **Menu Option 2: SEND DIGIT SEQUENCES** to send it. In some cases, there are points in the telephone network where it is essential to be able to send a Multi-Wink sequence in order to complete a call. In such instances, you would place the call to the Far-End Responder from the **SEND DIGIT SEQUENCES** menu. **Begin** at Menu Option 2: **SEND DIGIT SEQUENCES**. This display is repeated from Section 3-10.3.1



Enter the menu by pressing any softkey under the display and it becomes:

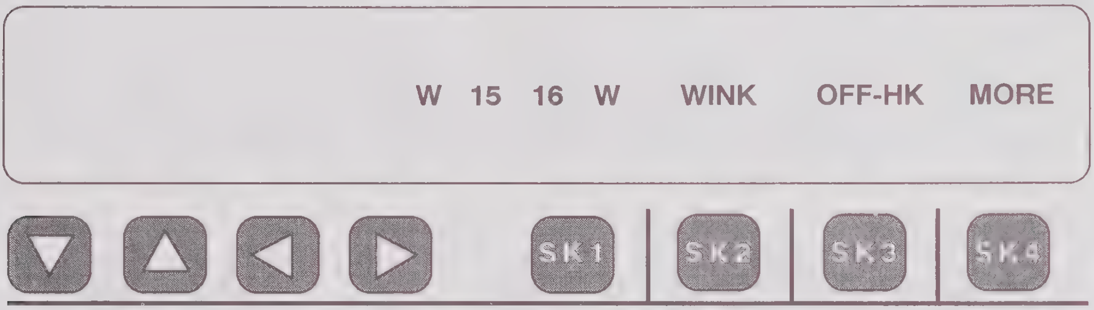


Press Softkey 4 (under **NO**) to send the call sequence once and the display changes to:



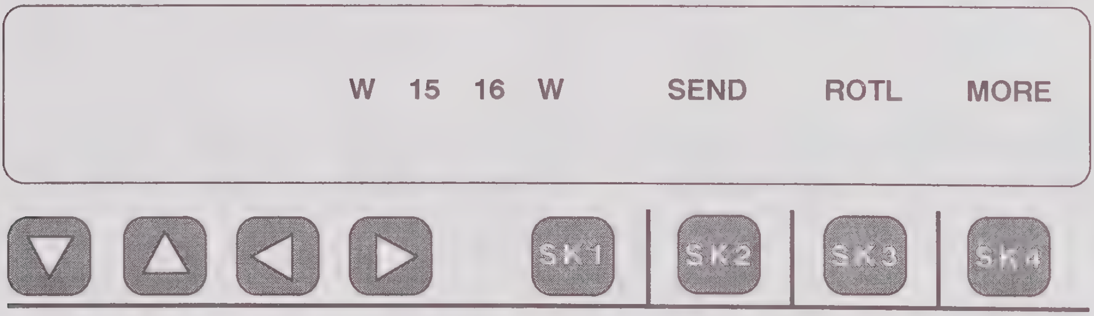
If any previously entered sequences are displayed, press the **CLEAR** key to obtain the above display.

As an example, simulate an Equal Access call sequence. This sequence will consist of two **MF** records: the **ANI** or calling number, and the **called number** which will be the test line's number. These two numbers will be stored in memory locations 15 and 16 using the procedure outlined in Section 3-10.3.1. After the winks and the two numbers have been correctly entered, the 930A display will look like the one below:

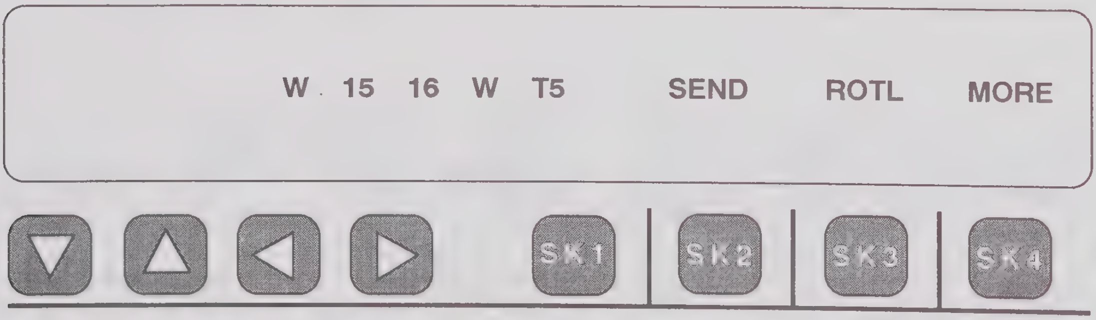


After entering the Feature Group D call sequence, the next step is to tell the 930A to become a manual **ROTL/Near End Responder** so that it will commence testing after the call completes.

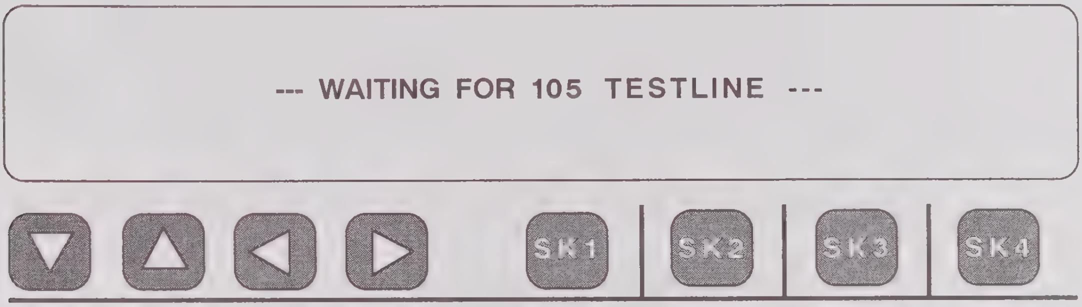
Press Softkey 4 (under **MORE**) until the 930A display is identical to:



You will need to place the **ROTL** function at the end of the sequence by pressing Softkey 3 (under **ROTL**). The 930A display will become:



To begin testing, place the front panel Hook Switch in the **OFF-HOOK** position and the 930A will outpulse the call. The 930A display will appear as follows until the call completes and testing begins:

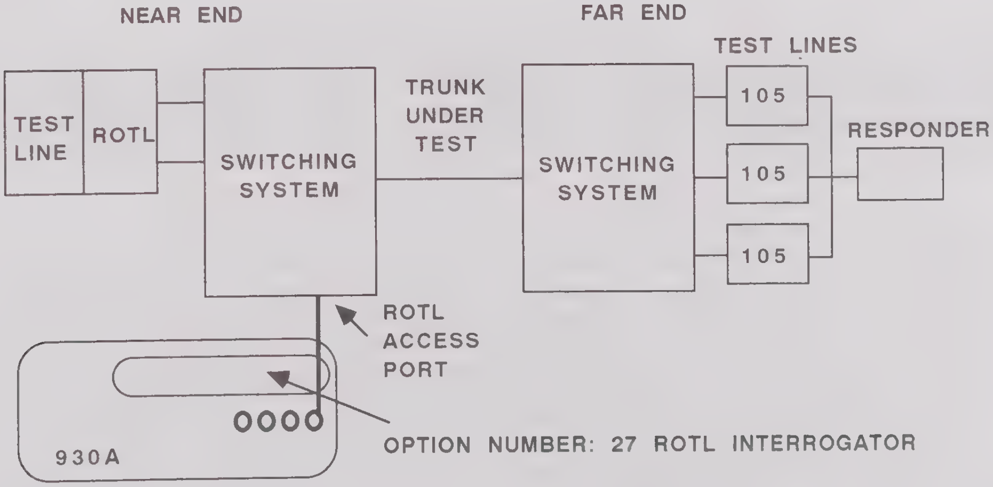


--- WAITING FOR 105 TESTLINE ---

When testing commences, the two-way test results will begin to appear.

4-6.3 USING THE 930A TO INTERROGATE A ROTL (MENU OPTION 27)

The Interrogator portion of Option 930A-12 lets the 930A command a **ROTL** from a **ROTL** access port or over a dial-up line. The 930A supports two-way transmission testing to type 105 test lines and one-way transmission testing to type 100 and 102 test lines. Operational balance and long term (**BALT**) tests can also be performed, but support for these tests is limited to the return of audible tones to the operator. A typical test line arrangement showing the 930A connected to the near end switch **ROTL access port** is shown below.



INTERROGATOR CONNECTED AT ROTL ACCESS PORT
FIGURE 4-6

Since the **ROTL** access port is usually tied up by the **CAROT** controller, the 930A can gain test access over any dial-up line, or **T-1 PCM** channel at the **DSX**, and interrogate the **ROTL** from there.

Before starting to test, you must set the 930A to the correct **TRUNK TYPE** (Refer to Section 3-4) before connecting the 930A to either the **ROTL** access port, the dial-up line, or the **DSX** (Select the Trunk Type for the connection between the 930A and the **ROTL**, **not** the line under test).

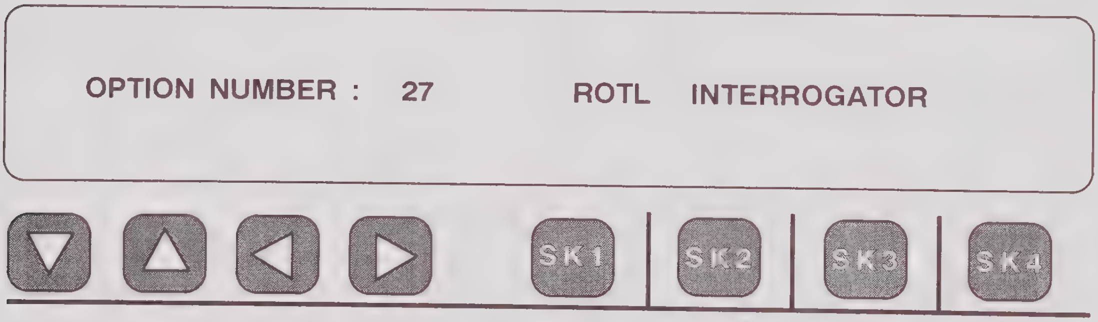
You can set up the 930A as an **Interrogator** by performing the following steps:

Press the Option Menu ■ ○ **Option Menu** key.

Use the UP/DOWN ▽ △ arrow keys

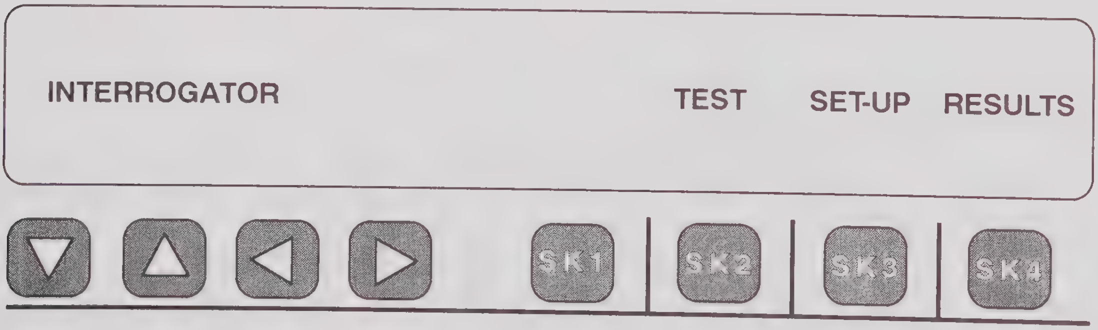
to select Menu Option 27: ROTL INTERROGATOR

The Model 930A display will appear as follows:



OPTION NUMBER : 27 ROTL INTERROGATOR

Press any softkey under the display and it becomes:

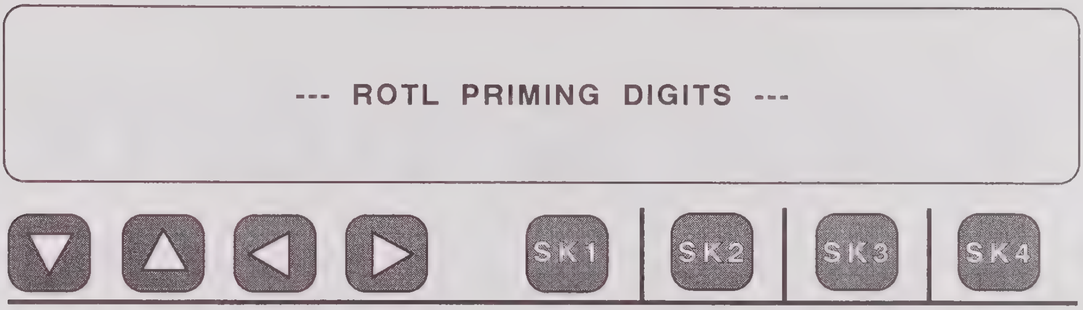


INTERROGATOR TEST SET-UP RESULTS

For this example, we will start from the beginning using the factory default displays. This means we have to start with the **SET-UP** menu before we can test.

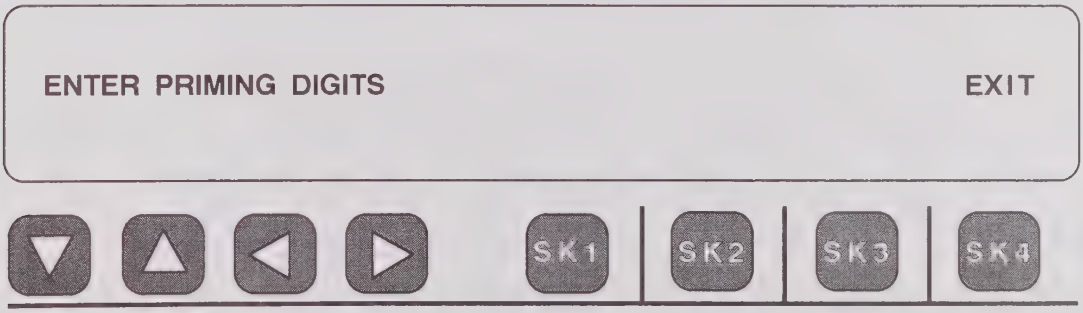
4-6.3.1 ENTERING THE ROTL PRIMING DIGITS

To begin, press Softkey 3 (under **SET-UP**). The 930A display will then briefly flash the following:



--- ROTL PRIMING DIGITS ---

If no priming digits have been entered, the display will prompt you by showing the following:



ENTER PRIMING DIGITS EXIT

If priming digits had previously been entered, as would normally be the case, then the last string of priming digits would have been displayed instead of the words "**ENTER PRIMING DIGITS**". If an unwanted string of digits is present, they can be removed by pressing the **CLR** key. New **ROTL** priming digits may now be entered by using the numeric keypad. **First**, however, it is necessary to say a few words about **ROTL** priming digit sequences and how the 930A displays them.

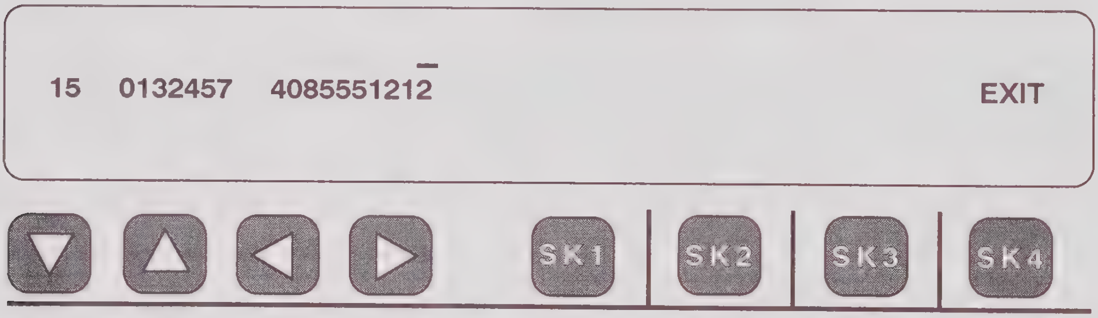
IMPORTANT NOTE:

ROTL priming digits are always MF digits. The 930A has been set

to automatically insert the KP and ST delimiters. You only have to enter the numerical digits. This is a deviation from the way in which the **DIAL/RING** Function operates.

You can enter up to thirty (30) digits in the **ROTL** priming digits field. These digits consist of the Test Type (up to 3 digits long), the Trunk Identification Number (up to 7 digits long) and the far-end Test Line number (up to 11 digits long). The 930A lets you enter blank characters between the groups for readability. These blank characters are inserted by the **UP** Arrow key and have no effect on outpulsing.

A typical 930A display of **ROTL** priming digits, with blank spaces inserted to separate the groups, might appear as shown below:



15 0132457 4085551212

In this example, the first two digits identify the Test Type (Transmission Test with Busy Override using a 105 Type test line in this case), the second group of 7 digits might be the Trunk Appearance Number (**TAN**) of a No. 4 ESS for example, and the last group is an example of a Far End Test Line number.

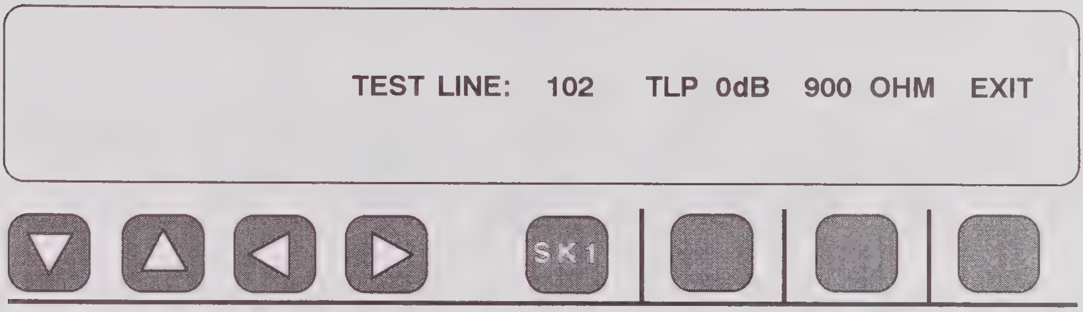
ROTL priming digit sequences vary in accordance with the type and vintage of switching equipment, the type of testing to be performed, the test lines available and their manufacturer. Tables of Priming Digit Formats for recent AT&T switches and for Northern Telecom, GTE and ITT switches, are provided at the end of this section.

You can edit the string of priming digits to insert or delete individual characters, rather than re-entering the entire string if a mistake, or an omission, has occurred. The **LEFT** and **RIGHT** Arrow keys move the cursor around the display. The **UP** Arrow key inserts a blank space. The **DOWN** arrow key deletes an unwanted digit.

The next section outlines the rest of the **SET-UP** procedure after you have entered the **ROTL** priming digits.

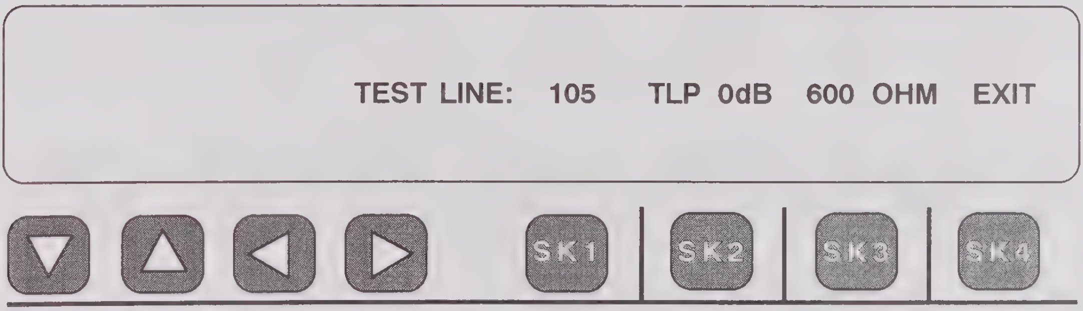
4-6.3.2 RESPONDER CONDITIONING SET-UP

After the priming digits have been entered, press Softkey 4 (under **EXIT**) to advance to the responder conditioning set-up display. A typical display is shown below:



TEST LINE: 102 TLP 0dB 900 OHM EXIT

Softkey 1 selects the type of far end test line the **ROTL** will be calling. The choices are Type 100, 102 or 105. **Softkey 2** selects the near end responder Transmission Level Point (**TLP**). The choices are 0 dB or -2 dB. **Softkey 3** selects 600 ohm or 900 ohm impedance for the trunk under test. For example, assume that the far end test line is a Type 105. The trunk under test is a 600 ohm circuit with a **TLP** of 0 dB. **To change the set-up** above, press Softkey 1 until the test line type shows **'105'**. Press softkey 3 to change from 900 to 600 ohms. The 930A display now appears as:

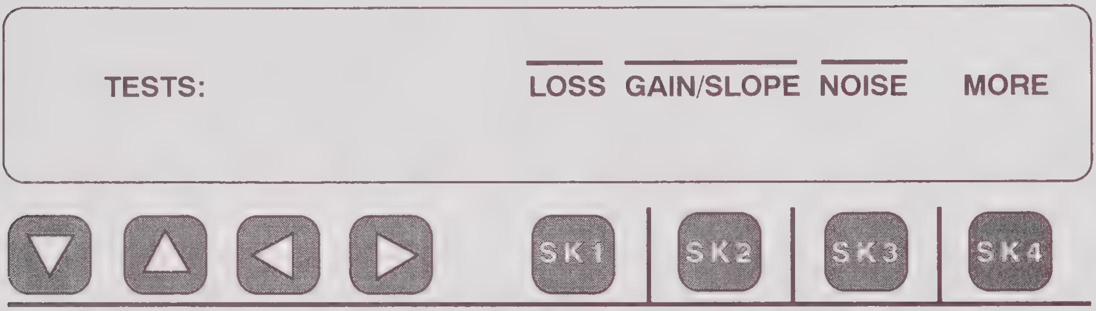


TEST LINE: 105 TLP 0dB 600 OHM EXIT

Press Softkey 4 (under **EXIT**) to move on to the test selection set-up display.

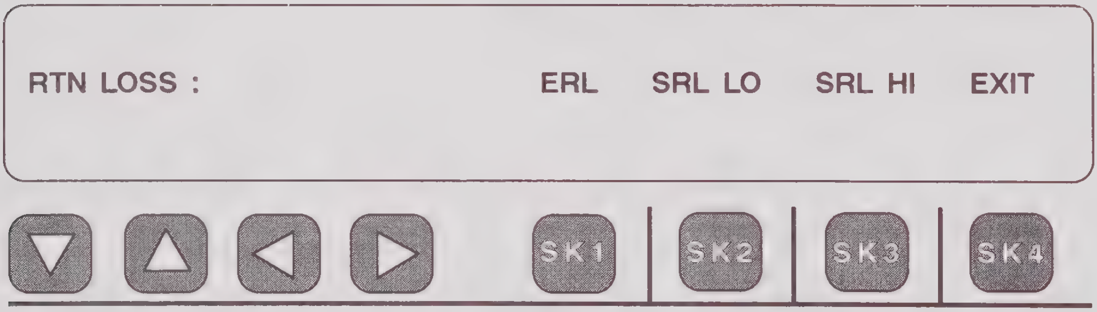
4-6.3.3 INTERROGATOR TEST SELECTION

The test selection display is shown below:



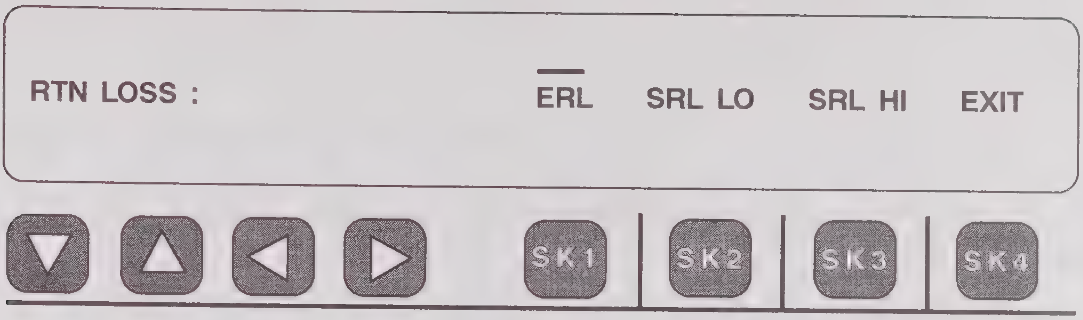
To select or de-select a test, press the softkey beneath the test. Tests which are selected will have a cursor over them, de-selected tests will not. **For two-way transmission testing** (Type 105), all tests would be selected. **If balance, or operational, testing** were being performed, **none** of the transmission tests would be selected. Press Softkey 4 (under **MORE**) to continue the selection process.

Pressing Softkey 4 (under **MORE**) brings up the following display:



Notice that **none** of the return loss tests have previously been selected. Many test lines do not support return loss testing or support only Echo Return Loss (**ERL**). Assume that the Type 105 test line being accessed has **ERL** capability. Press Softkey 1 (under **ERL**) to select **ERL** testing. Leave the other Return Loss tests de-selected.

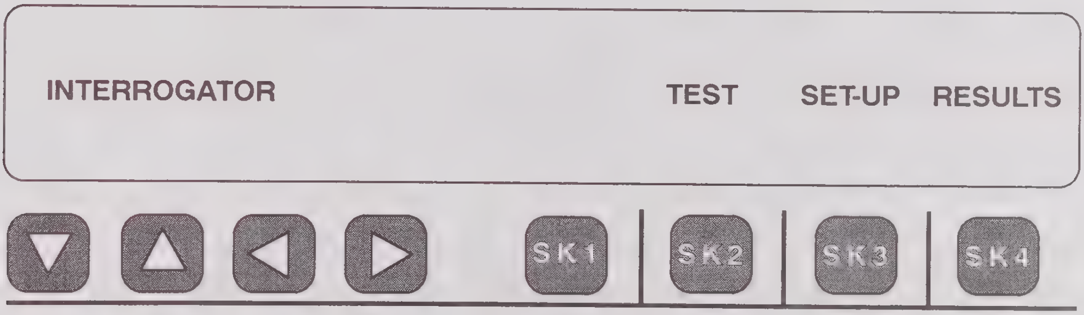
The 930A display will be:



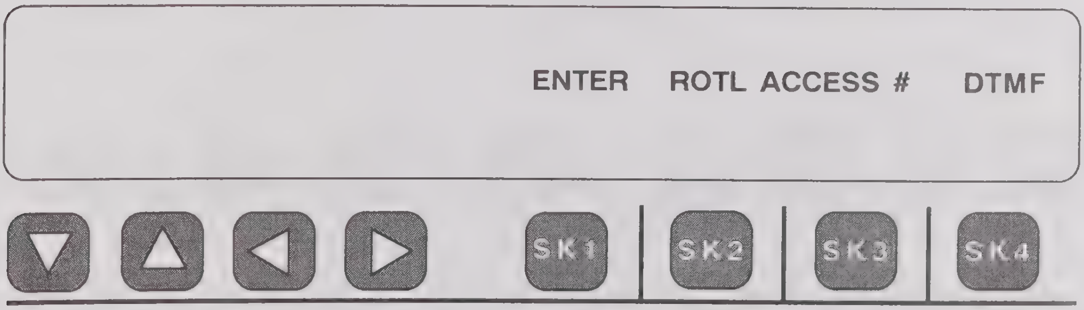
Now that the **INTERROGATOR** function is set, press Softkey 4 (under **EXIT**) to return to the main Interrogator menu.

4-6.3.4 TESTING WITH THE INTERROGATOR FUNCTION

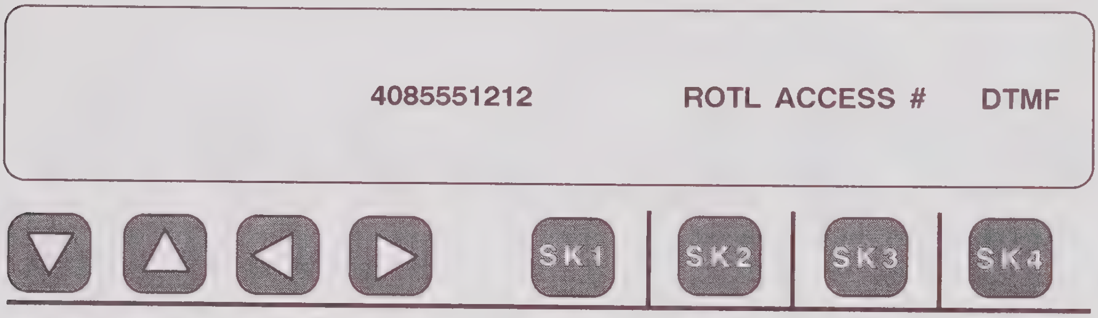
The main Interrogator display is shown below for discussion purposes.



To begin testing, after you have set the Interrogator up, press Softkey 2 (under **TEST**). The 930A display will then change to one of two possible displays. **If no ROTL Access number** has previously been entered, the 930A will prompt the user to enter one as shown below:



The number may be **DTMF**, **MF** or **DP**. You select the correct form by pressing Softkey 4 until the type you want is displayed. Then enter the **ROTL Access Number**. If a number had already been entered, it would have been displayed instead, as shown below:

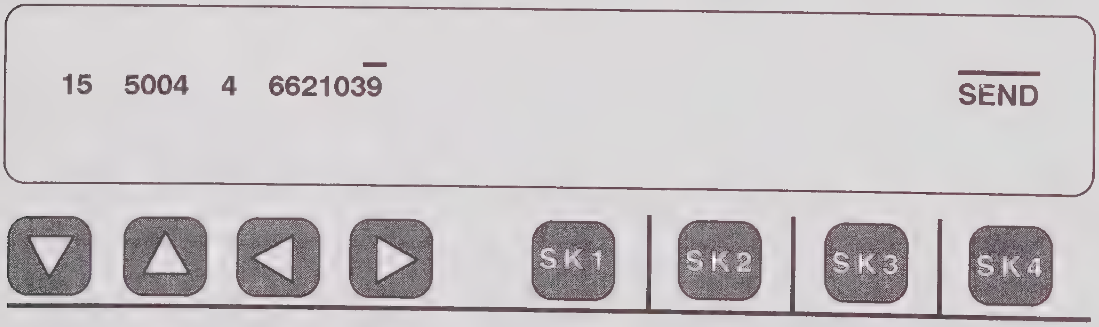


4085551212 ROTL ACCESS # DTMF

This could just as well have been a **DP** or an **MF** sequence. The above is for example purposes only. If another number is desired, press the **CLR** key and enter the new number.

If the 930A is connected directly to the **ROTL access port** of a switch, **no** number is required. Press the **CLR** key to remove any existing numbers and then go **OFF HOOK**. **If the 930A is connected to a dial-up line**, or at the **DSX**, place the front panel hook switch in the **OFF HOOK** position to send the call sequence.

In either case, you will see a Call Progress indication on the display (Busy Signal, etc.) as well as an audible indication. The 930A automatically advances to the **ROTL priming** screen when you go **OFF HOOK**. **You must wait** until the audible indication of call completion before sending the **ROTL** priming digits. A typical **ROTL** priming screen is shown below:



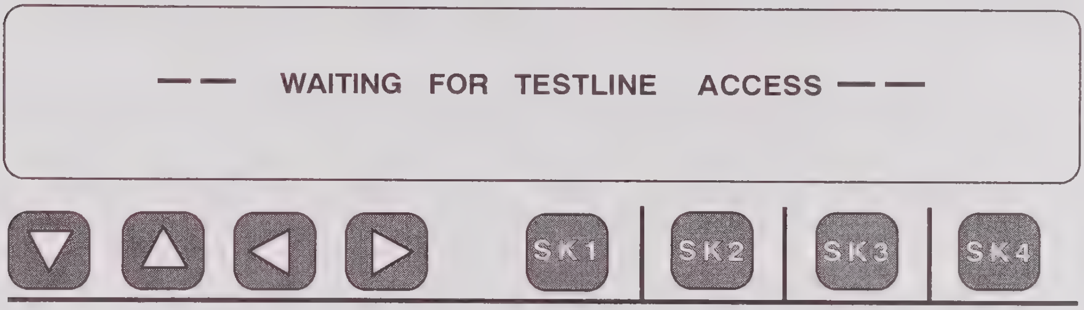
15 5004 4 6621039 SEND

The flashing cursor over **SEND** prompts you to press Softkey 4 to outpulse the **ROTL priming digits,** **after** the **ROTL access** has been obtained.

If the 930A is operating under remote control, the priming digits will be outpulsed automatically when the **ROTL** is accessed.

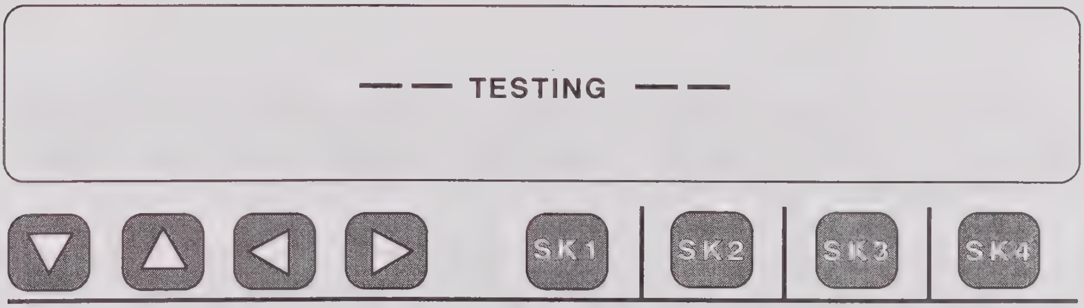
You can stop testing (if, for example, the **ROTL** is busy) by going **On-Hook**.

After Softkey 4 (under **SEND**) has been pressed, the 930A display will change to the following:



— — WAITING FOR TESTLINE ACCESS — —

At this point the 930A waits to receive the test progress tones before continuing. Once these have been received, the 930A begins testing and the display will momentarily appear as:

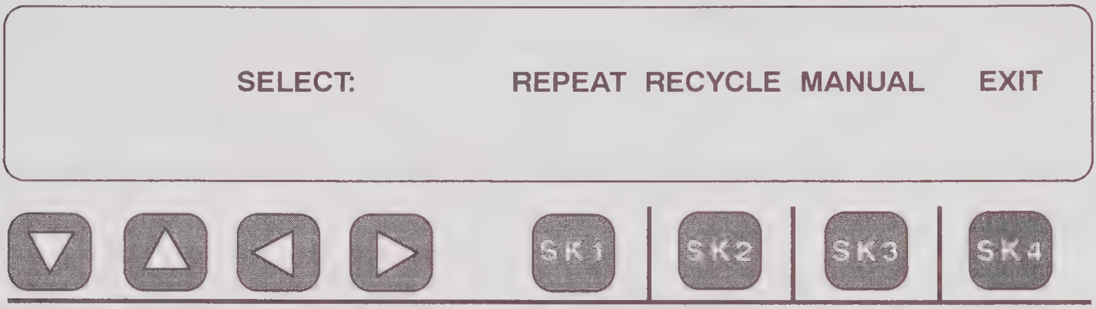


— — TESTING — —

The tests are audible, and test results will begin to show on the display, just as the ROTL/Responder test results in Section 4-6.2 were displayed.

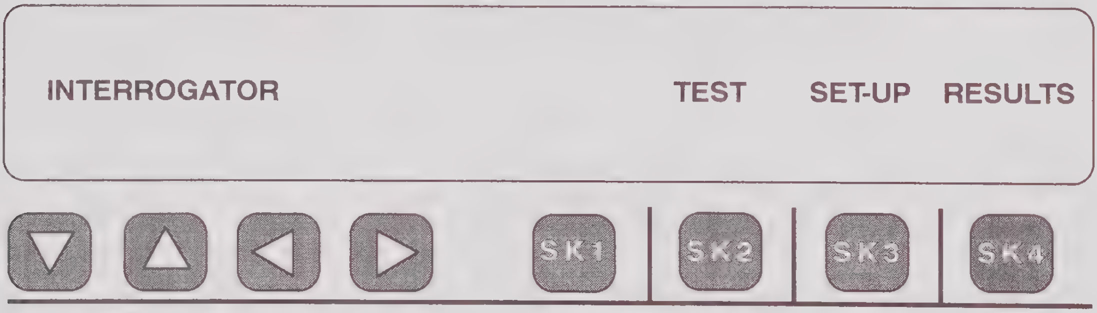
The 930A sequences through the selected tests at a fairly rapid rate and flashes the results of each test briefly to indicate that it is still testing.

Once the tests have been completed, the 930A will automatically present the **Selection** display shown below:



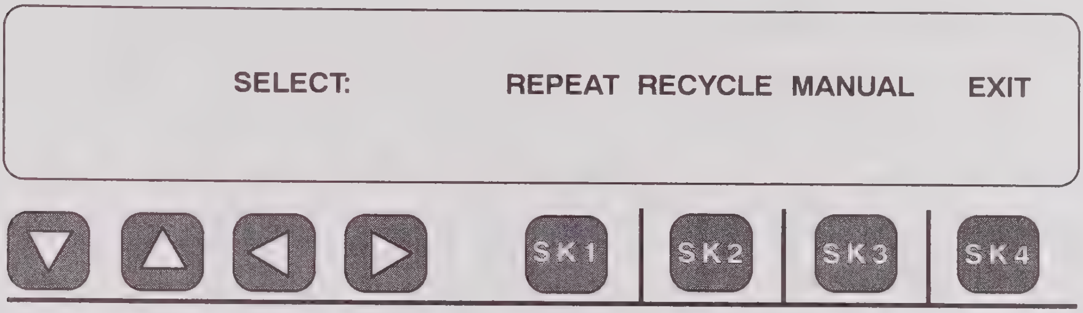
At this point, **the 930A remains connected** to the **ROTL**, the Trunk Under Test (**TUT**) and the Far-End Test Line (**FETL**), and testing can continue. The **RECYCLE** command will release the **TUT** and **FETL**, **while holding the ROTL** for further testing. **To release the ROTL**, go **On Hook**.

To review the results of the previous test, press Softkey 4 (under **EXIT**) to bring back the main Interrogator display shown below:



Pressing Softkey 4 (under **RESULTS**) will bring up the results of the last testing. To scroll through the results, use the **UP/DOWN** arrow keys. This would be identical to the operation of the **ROTL/Responder** described in Section 4-6.2.

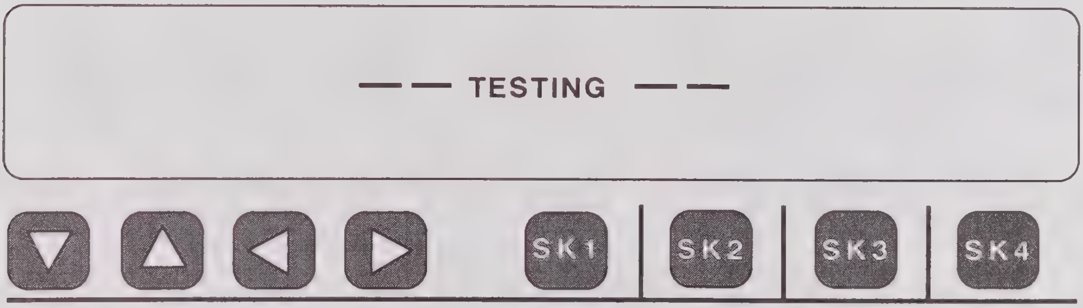
The **Selection** display enables you to do more than just review the results of the previous tests.



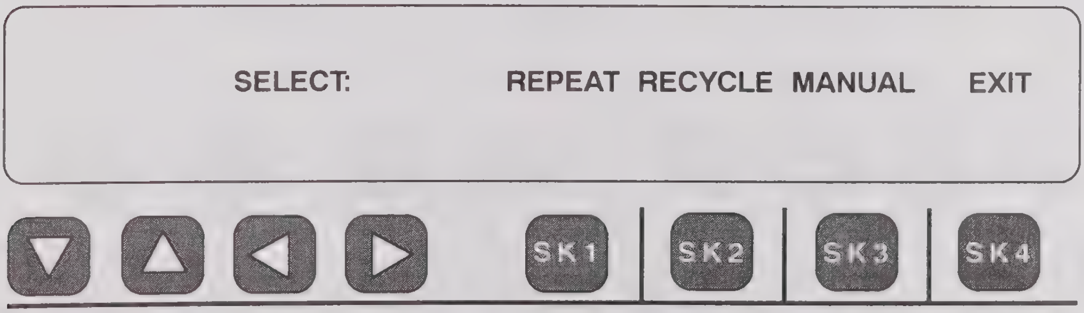
The four softkeys are labeled **REPEAT**, **RECYCLE**, **MANUAL** and **EXIT**.

The **REPEAT** function reruns the previously set-up test sequence. This enables you to repeat a test without re-entering the set-ups.

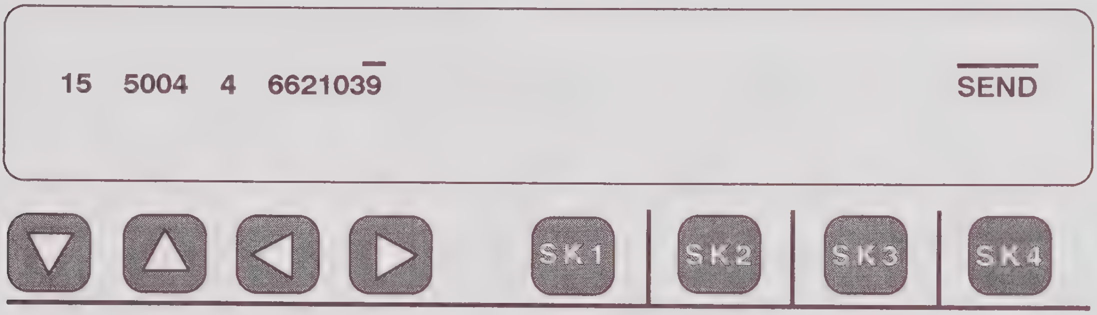
Press Softkey 1 (under **REPEAT**) in the **SELECT** display and the 930A will rerun the previous test. The 930A display will revert to:



When testing is completed, the 930A returns to the **SELECT** display:

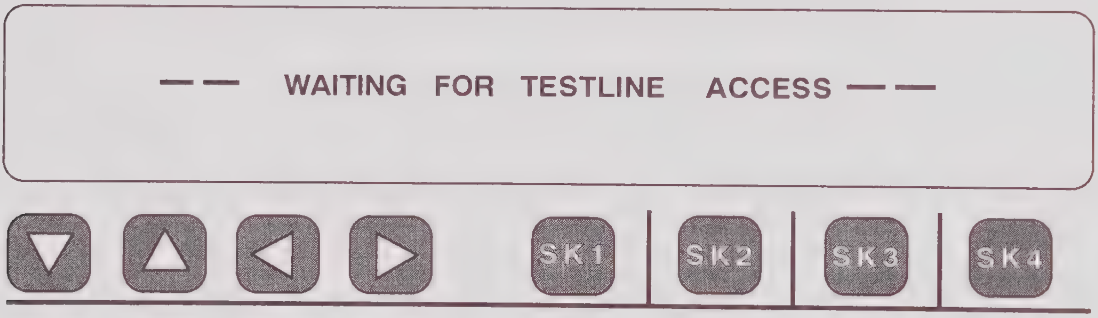


The **RECYCLE** function sends the 1300 Hz "recycle" command to the **ROTL**, then takes the 930A back to the priming digits display shown below:



```
15   5004   4   6621039                              SEND
```

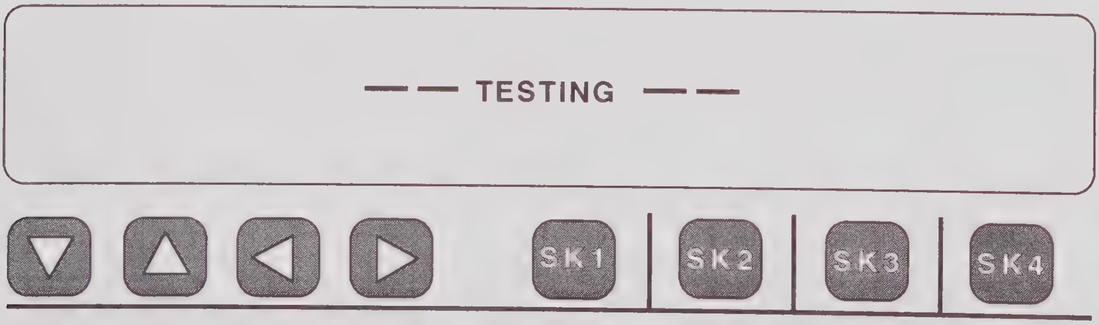
You can now edit the **ROTL priming digits**. When the new number has been entered, press Softkey 4 (under **SEND**) to send the new **ROTL** priming digits. The 930A would display the following:



```
—— WAITING FOR TESTLINE ACCESS ——
```

The 930A waits to receive the three consecutive test progress tones and then starts testing.

When the 930A begins testing, the display first shows:

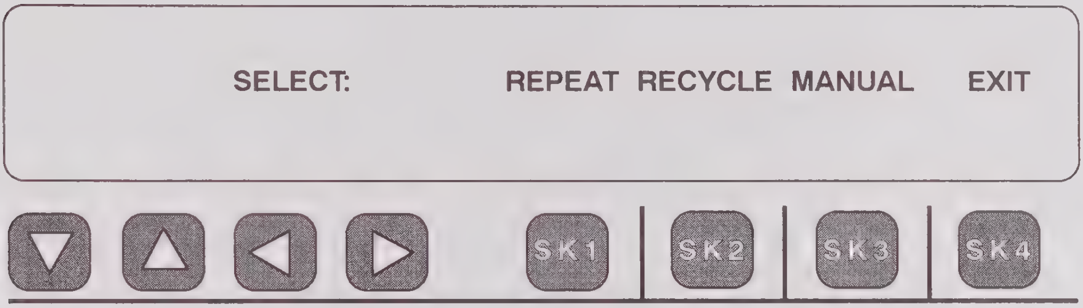


```
—— TESTING ——
```

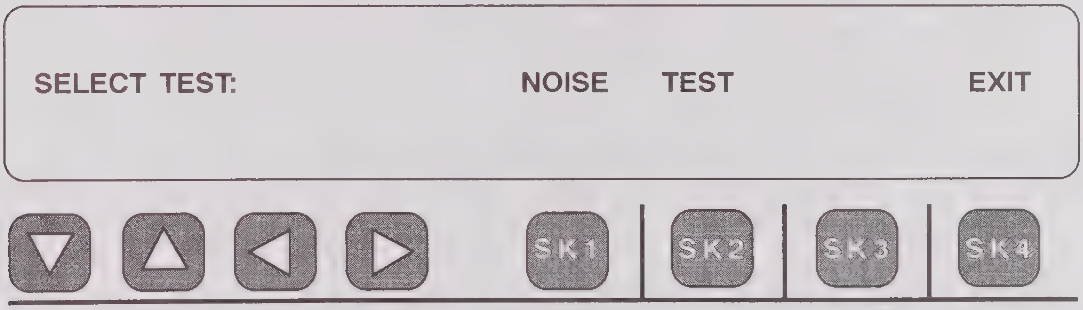
The 930A will start to receive and display the test results soon after the above display appears and the series of results will be displayed in much the same manner as the original test results, although the actual results will be different.

Finally, you may wish to repeat a single test, or series of tests, under **manual** control.

To Manually repeat a single test, start at the main **SELECT** screen:



Press Softkey 3 (under **MANUAL**) and the display changes to the following:



The Noise test is displayed in this instance. **To choose any other test**, press Softkey 1 until the desired test appears. The choices are **LOSS, GAIN/SLOPE, NOISE, NOISE WITH TONE, ECHO RETURN LOSS, SINGING RETURN LOSS-LO, AND SINGING RETURN LOSS-HI**. Once the desired test has been selected, press Softkey 2 (under **TEST**) to begin testing.

Pressing Softkey 4 (under **EXIT**) will bring back the main **SELECT** display.

4-6.3.5 TABLES OF ROTL PRIMING DIGITS

The following Tables are intended for two-way Transmission They are not complete lists of all **ROTL Priming Digits** for all types of tests such as Terminal Balance, Connection Appraisal, etc.

TABLE 4-4
STEP-BY-STEP OFFICE MINI-ROTL PRIMING DIGIT FORMAT

TEST TYPE	TEST LINE	DIGITS					
		1	2	3	4 5 6	7	8 9 10 11 12 13 14 15 16 17 18
TRANSMISSION TESTS	100	0	0	0	**TRUNK ID**	**NOTE**	**FAR END TESTLINE NUMBER**
	102	0	2	0			
	105	0	5	0			

NOTE: The seventh digit depends upon the Trunk Type

DIGITS	TRUNK TYPE
0	Dial Pulse on Loop Supervision Trunk
1	Dial Pulse on Loop Supervision with Stop Dial
2	Dial Pulse on Simplex Supervision Trunk
3	Dial Pulse on Simplex Supervision with Stop Dial
4	MF Signaling on Loop Supervision Trunk
5	MF Signaling on Simplex Supervision Trunk

TABLE 4-5
STEP-BY-STEP OFFICE EXPANDED FORMAT

TEST TYPE	TEST LINE	DIGITS			
		1 2	3 4 5 6	7	8 9 10 11 12 13 14 15 16 17 18
TRANSMISSION TESTS	100	0 0	TRUNK ID	NOTE	FAR END TESTLINE NUMBER
	102	0 2			
	105	0 5			
TRANSMISSION TESTS WITH BUSY OVERRIDE	100	1 0			
	102	1 2			
	105	1 5			

NOTE: The seventh digit depends upon the Trunk Type

DIGITS	TRUNK TYPE
0	Dial Pulse on Loop Supervision Trunk
1	Dial Pulse on Loop Supervision with Stop Dial
2	Dial Pulse on Simplex Supervision Trunk
3	Dial Pulse on Simplex Supervision with Stop Dial
4	MF Signaling on Loop Supervision Trunk
5	MF Signaling on Simplex Supervision Trunk

TABLE 4-6
NO. 1 ESS ROTL PRIMING DIGITS FORMAT

TEST TYPE	TEST LINE	DIGITS			
		1 2	3	4 5 6 7 8 9	10 11 12 13 14 15 16 17 18 19 20
TRANSMISSION TESTS	100	0 0	NOTE	TRUNK NETWORK NUMBER	FAR-END TEST LINE NUMBER
	102	0 2			
	105	0 5			
TRANSMISSION TESTS WITH BUSY OVERRIDE	100	1 0			
	102	1 2			
	105	1 5			

NOTE: The third digit is a modifier digit:

1) 0 = Local originating mode.
2) 1 = Tandem 1 (2-Wire tandem configuration with transformers).
3) 2 = Tandem 2 (4-Wire to 2-Wire tandem configuration without transformers).

TABLE 4-7
NO. 4 ESS ROTL PRIMING DIGITS FORMAT

TEST TYPE	TEST LINE	DIGITS		
		1 2	3 4 5 6 7 8 9	10 11 12 13 14 15 16
TRANSMISSION TESTS	100	0 0	TRUNK ID FOR TRUNK APPEARANCE NUMBER	FAR END TESTLINE NUMBER
	102	0 2		
	105	0 5		
TRANSMISSION TESTS WITH BUSY OVERRIDE	100	1 0		
	102	1 2		
	105	1 5		

TABLE 4-8
GTD-5, ITT 1210 PRIMING DIGITS FORMAT

TEST TYPE	TEST LINE	DIGITS				
		1 2	3	4 5 6	7 8 9	10 11 12 13 14 15 16 17 18 19 20
TRANSMISSION TESTS	100	0 0	NOTE 1	NOTE 2	NOTE 3	FAR-END TEST LINE NUMBER
	102	0 2				
	105	0 5				
TRANSMISSION TESTS WITH BUSY OVERRIDE	100	1 0				
	102	1 2				
	105	1 5				

NOTE 1: The third digit is a modifier:
1) 0= Talk tandem Off-Hook state without a transformer in the talk path.
2) 1= Talk tandem Off-Hook state with a transformer in the talk path.

NOTE 2: Three digit Trunk Group Number

NOTE 3: Three digit Trunk Group Member Number

TABLE 4-9
DMS 100/200 ROTL PRIMING DIGITS FORMAT

TEST TYPE	TEST LINE	DIGITS				
		1 2	3 4 5 6	7 8 9 10	11 12 13	14 15 16 17 18 19 20 21
TRANSMISSION TESTS	100	0 0	TRUNK GROUP NMBR	TRUNK GROUP MEMBER NUMBER	NOT SENT TO DMS 100/200	FAR END TESTLINE NUMBER
	102	0 2				
	105	0 5				
TRANSMISSION TESTS WITH BUSY OVERRIDE	100	1 0				
	102	1 2				
	105	1 5				

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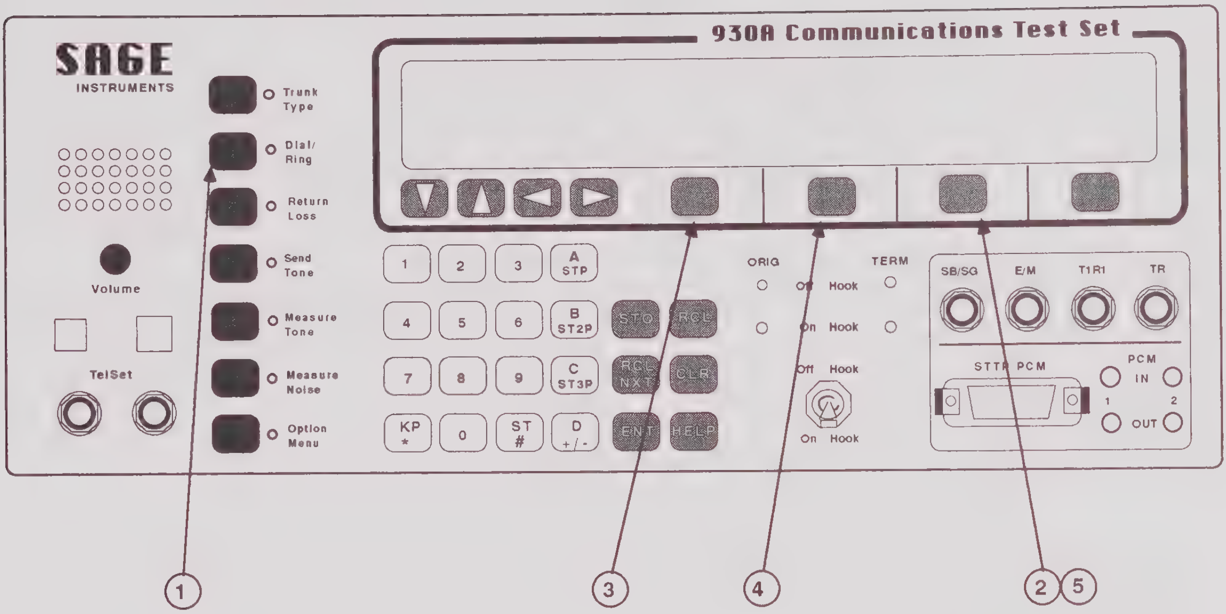


To select the **RING** mode of operation:

1. Press the **DIAL/RING** Function key.
2. Press Softkey 3 until the display indicates **RING**.
3. Press Softkey 1 (under **MANUAL**) to cause Ringing.
4. Press Softkey 2 (under **RPT?**) to cause intermittent Ringing.
5. Press Softkey 3 to reenter the **DIAL** mode.

CAUTION

THE RING GENERATOR CAN PRODUCE
POTENTIALLY DANGEROUS VOLTAGE LEVELS.
DO NOT TOUCH TEST LEADS WHILE GENERATOR IS OPERATING.

RING GENERATOR OPERATION
FIGURE 4-7

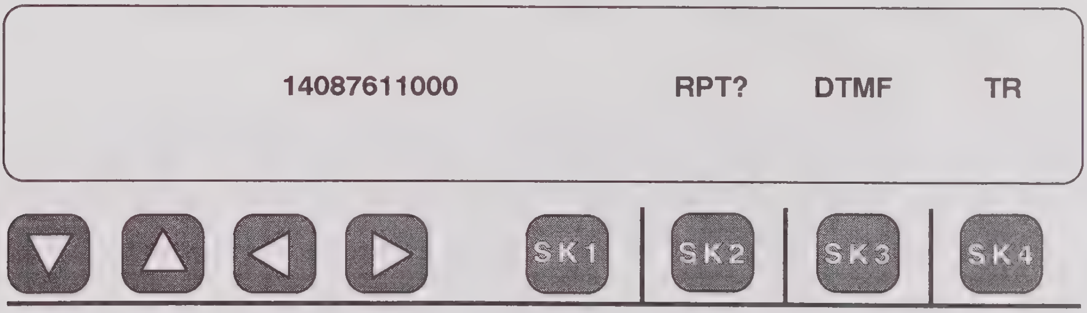
4-7 THE RING GENERATOR AND REN-3 LOAD (OPTION 930A-13)

The 930A may be equipped with a Ring Generator and Ringer Equivalent Number 3 Load by installing Option 930A-13. This option provides a nominal sinewave ringing voltage of 87 Volts RMS at 20 Hz. The **ringing voltage** level, **ringing frequency** and **ON/OFF** times are adjustable. A true Ringer Equivalent Number 3 (**REN-3**) load is also provided (Menu Option 5) to terminate ringing supplies. The Ring Generator is intended for operation on 2- and 4-wire Loop and Ground Start trunks. **Before using the Ring Generator**, select the correct **TRUNK TYPE** as described in Section 3-4.

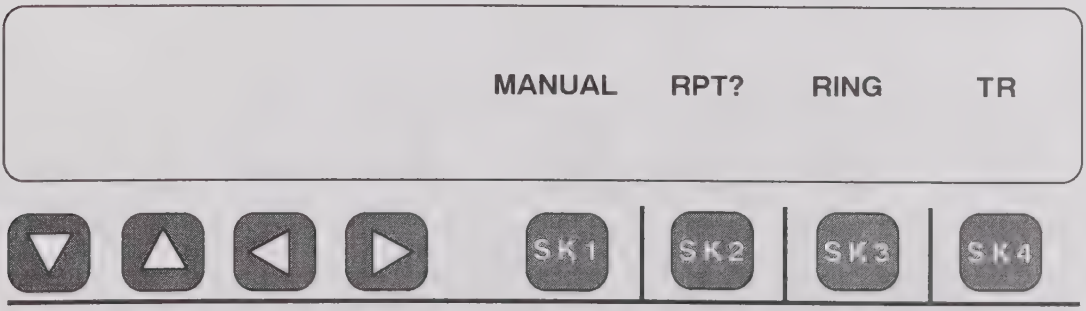
The following steps outline the set-up and operation of the Ring Generator. **To begin:**

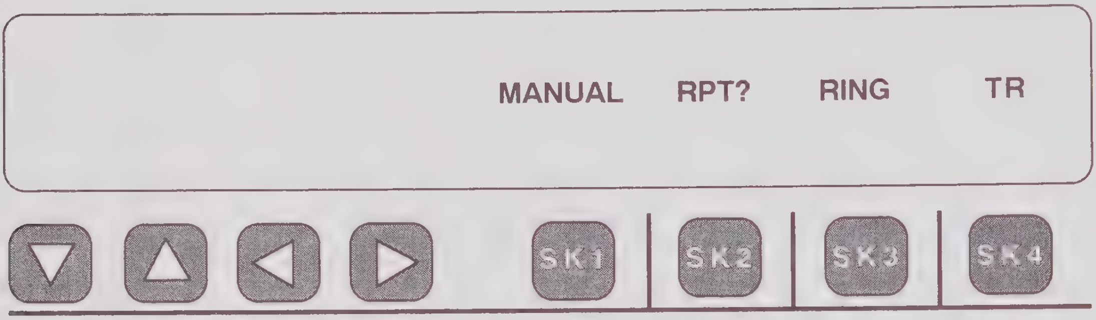
Press the DIAL/RING function key.

An example of a typical 930A display in **DIAL/RING** mode is shown below:



The 930A "remembers" the last settings, and in this example, the last thing done in **Dial/Ring** was to send the **DTMF** call shown. **To select the Ring Generator**, press Softkey 3 (under **DTMF** in the above display) until the following display appears.





To cause RINGING at the Tip/Ring jack, press Softkey 1 (under **MANUAL**) and the voltage will remain as long as Softkey 1 is held down.

To cause Intermittent Ringing continuously at the T/R jack, press Softkey 2 (under **RPT?**).

To return to the DIAL mode of operation, press Softkey 3 (under **RING**). Softkey 4 is inactive.

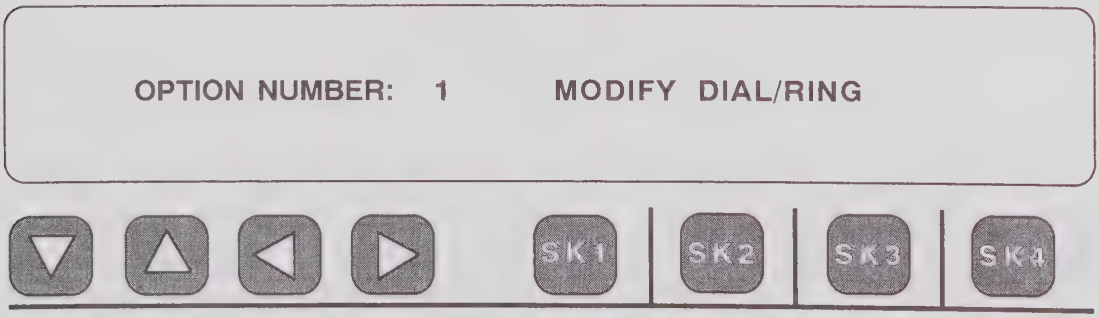
4-7.1 CHANGING THE RING GENERATOR LEVEL AND FREQUENCY (MENU OPTION 1)

Menu Option 1: **MODIFY SEND DIGITS**, is used to modify the amplitude, frequency and timing of the Ring Generator in the same way outpulsed digits were modified (Section 3-10.2). To change the default values, after selecting the **RING** mode of operation, do the following:

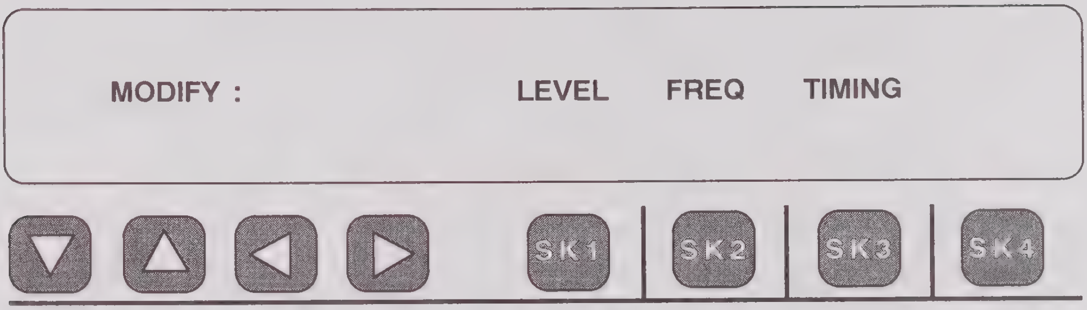
Press the OPTION MENU function key.

Use the UP/DOWN arrow keys to

select Menu Option 1: MODIFY DIAL/RING.

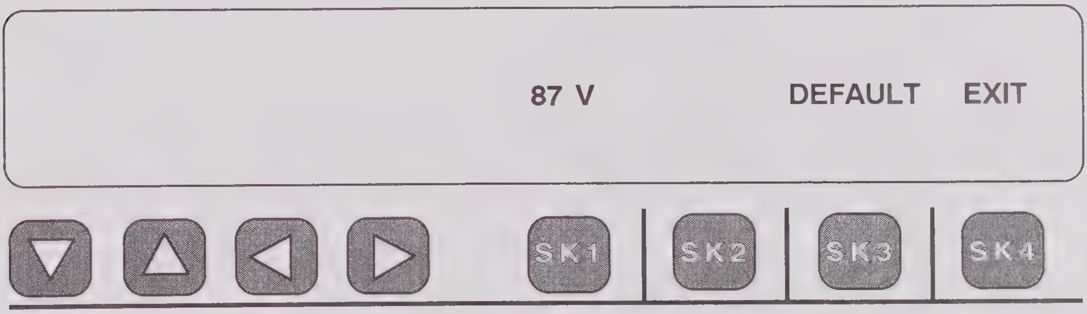


Press any softkey under the display to bring up:

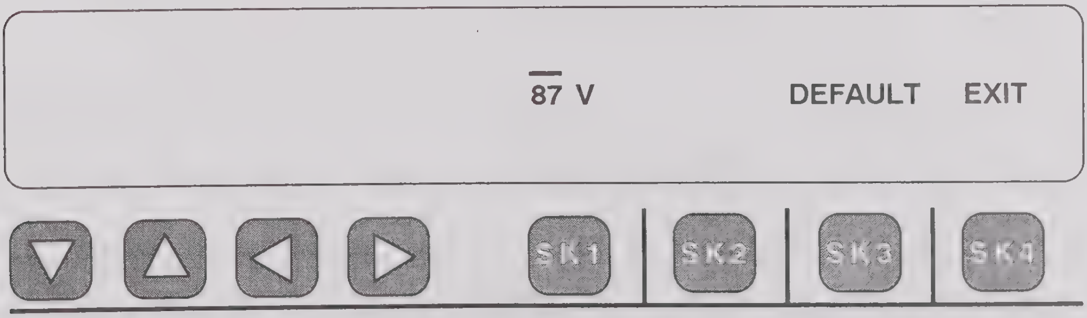


Press Softkey 1 to inspect or modify **Ringer level**.
Press Softkey 2 to inspect or modify **Ringer frequency**.
Press Softkey 3 to inspect or modify **Ringer On/Off time**.
Press the **OPTION MENU** function key to exit the menu.

Pressing Softkey 1 (under **LEVEL**) will bring up the following display:

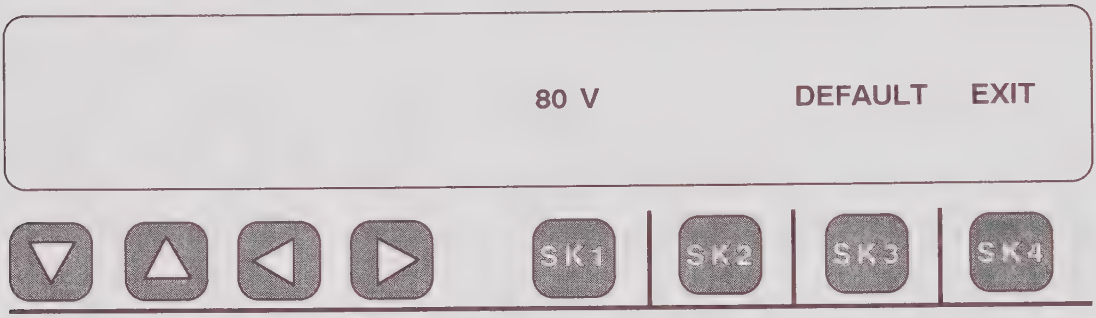


Enter the voltage you want using the keypad. For example, suppose you want 80 Volts RMS instead of 87. Press Softkey 1 and a cursor will appear over the present value as shown:



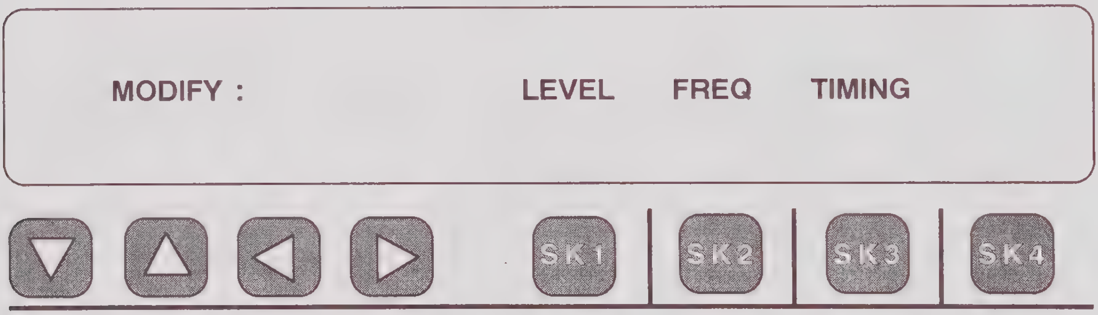
Enter the desired value (**80**) using the keypad and press the **ENTER** key.

The 930A display will become:

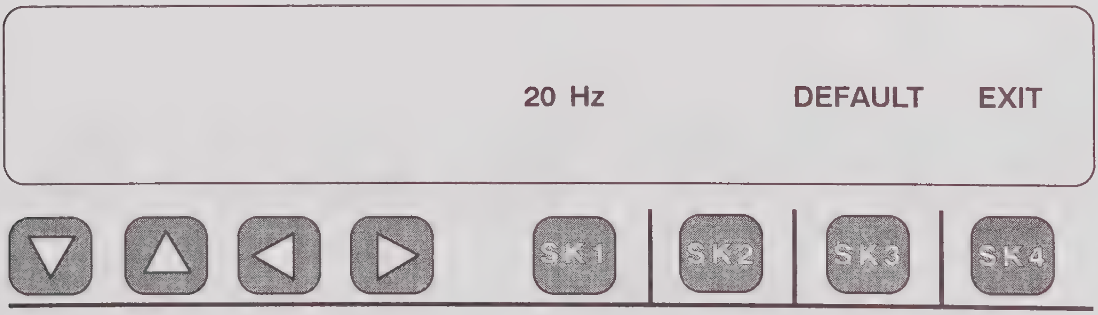


Pressing Softkey 4 (under **EXIT**) returns the display to the Option Menu. **Pressing the DIAL/RING** key returns the 930A to the **RING** mode. The ringing voltage output from the **TR (or T1R1)** jack will now be 80 Volts RMS whenever the **RING** function was used. Note the **">"** marker which precedes the **RING** mode identifier to alert you that a parameter (**LEVEL** in this case) has been modified.

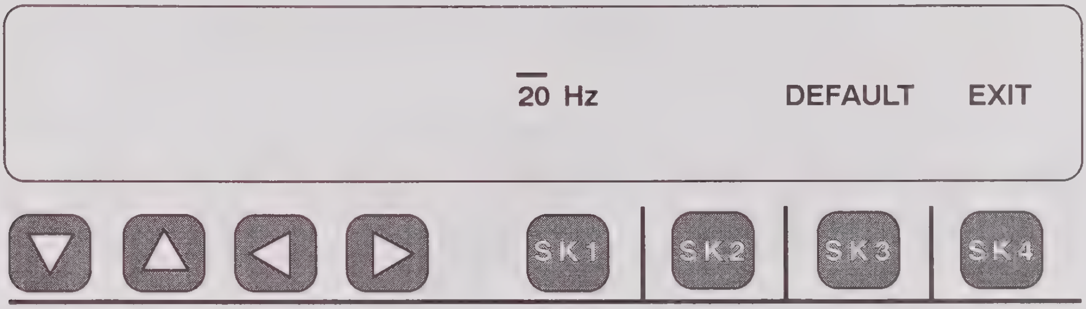
You can also change the **Ring frequency** from the default value of 20 Hz to some other value. You may want to change the **Ring frequency** to 30 Hz instead of the 20 Hz default. The main menu is repeated below:



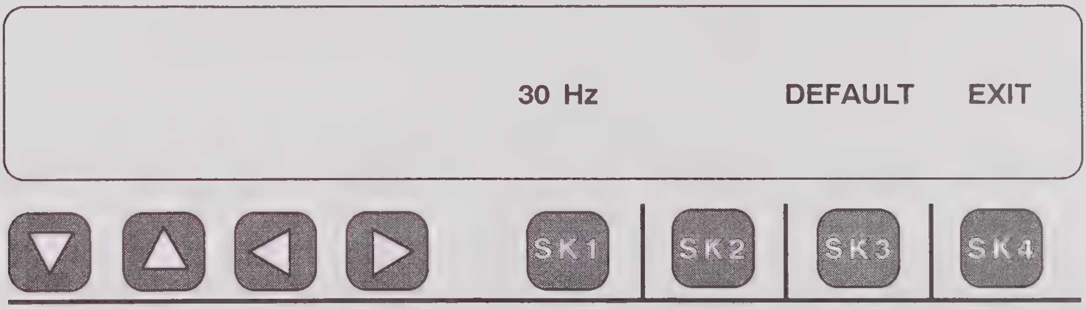
To change the Ring frequency, press Softkey 2 (under **FREQ**) to get:



Press Softkey 1 and a cursor appears over the 20 Hz display indicating that the value can now be changed. The display is as follows:

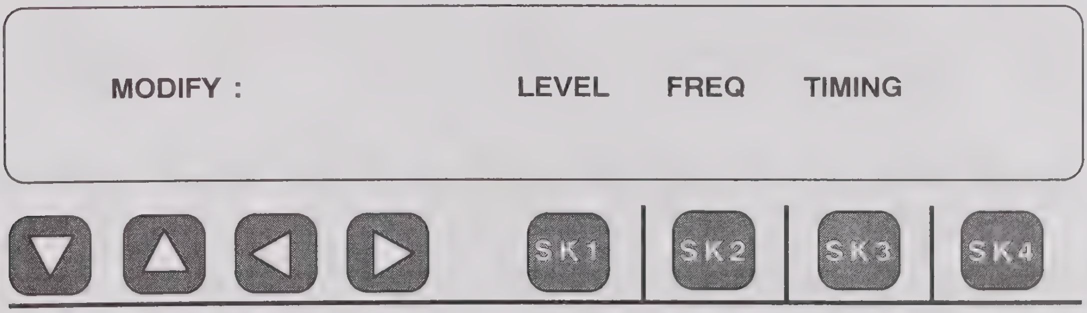


Enter the frequency you want from the keypad (3 and 0 in this example) and then press the **ENTER** key. The 930A display will change to:

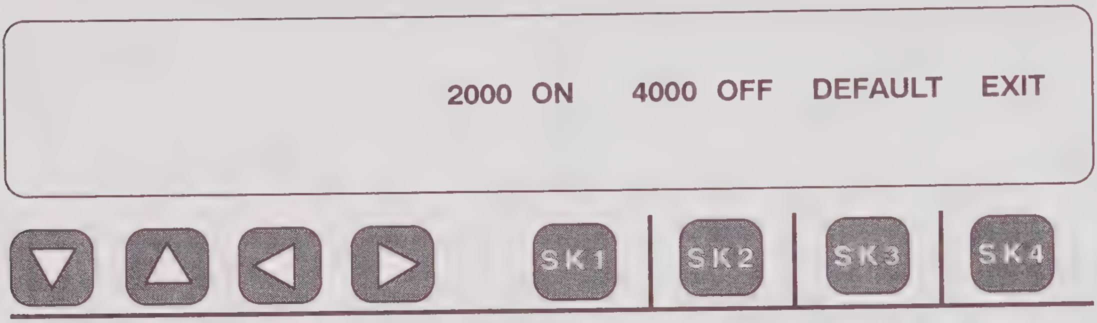


Press Softkey 4 to **exit** back to the Option Menu. **Press the DIAL/RING** key to go directly to the **RING** mode. The Ringing frequency will now be 30 Hz whenever the **MANUAL** or **RPT?** Softkeys are pressed. **To return to the factory default** values, press Softkey 3 (under **DEFAULT**).

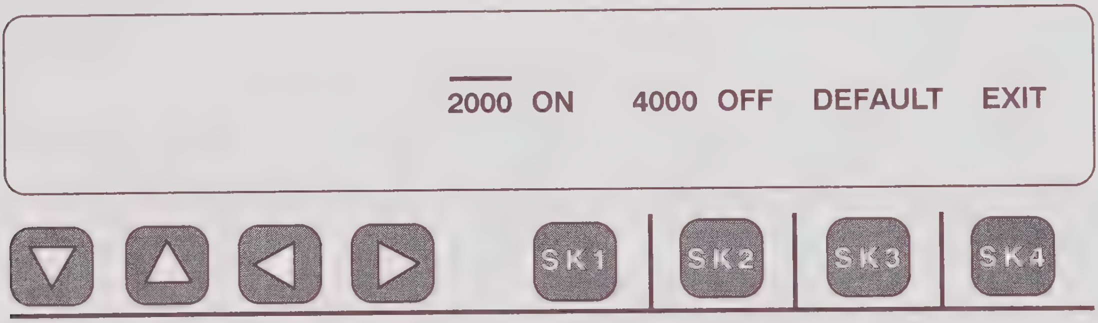
To modify the **ON/OFF** Ringer interval timing, return to the selection menu by pressing Softkey 4 or the **OPTION MENU** Function key. The selection display is repeated below:



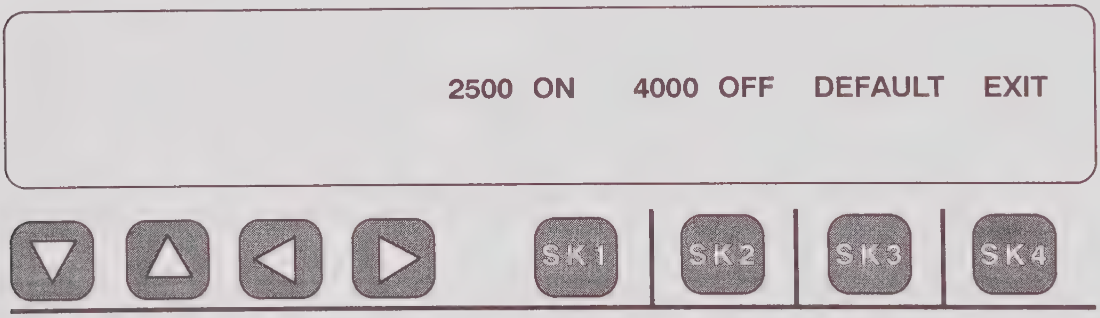
Press Softkey 3 (under **TIMING**) and the 930A display will change to:



In this case, a 2000 millisecond (2 second) **ON** and 4000 millisecond (4 second) **OFF** time interval (the default values) is displayed. To change the **ON** time to another value, **press Softkey 1** and a cursor will appear over the present **ON** time value, as shown below:



To change the **ON** time to 2.5 seconds for example, use the Numeric keypad to enter **2, 5, 0, 0** and press **ENTER**. The 930A display will change to:



Press Softkey 4 to exit back to the selection menu, or press the **DIAL/RING** Function key to go to the **RING** mode.

Press Softkey 3 (under **DEFAULT**) to restore the factory settings.

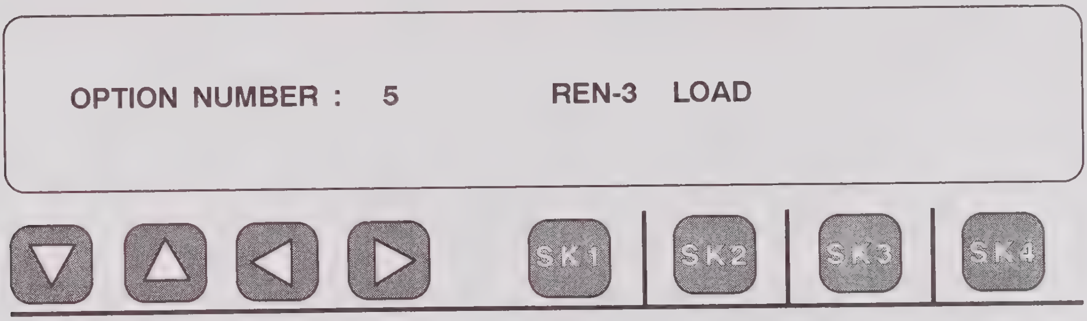
4-7.2 MEASURING RINGER VOLTAGE AND FREQUENCY USING THE REN-3 LOAD (MENU OPTION 5)

To make the 930A act as a **Ringer Equivalent Number 3 (REN-3)** load, perform the following steps:

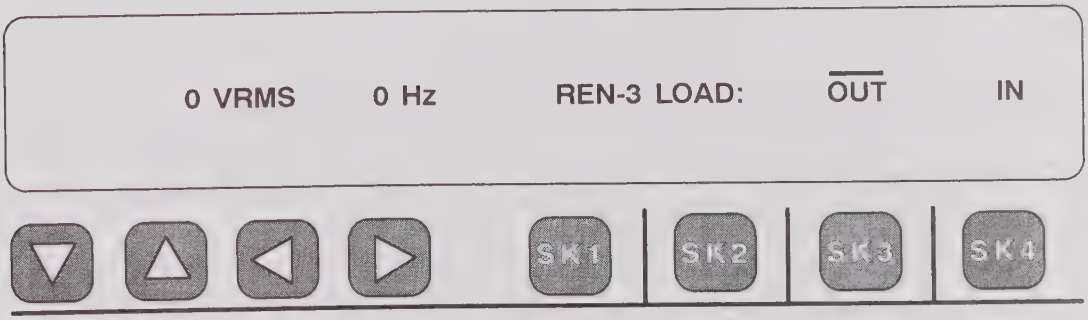
Press the OPTION MENU function key.

Use the UP/DOWN ▽ △ arrow keys to

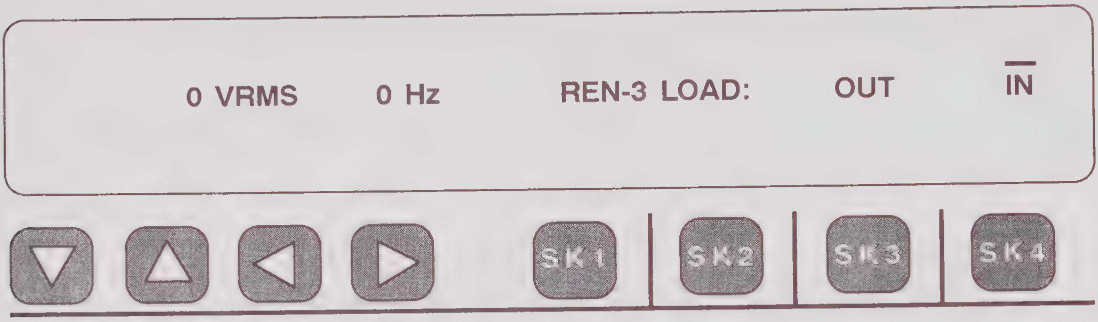
select Menu Option 5: REN-3 LOAD.


OPTION NUMBER : 5 REN-3 LOAD

If you have selected 2-wire LOOP or **GROUND START** Trunk Type, the 930A display will first appear as shown below when you press any softkey:

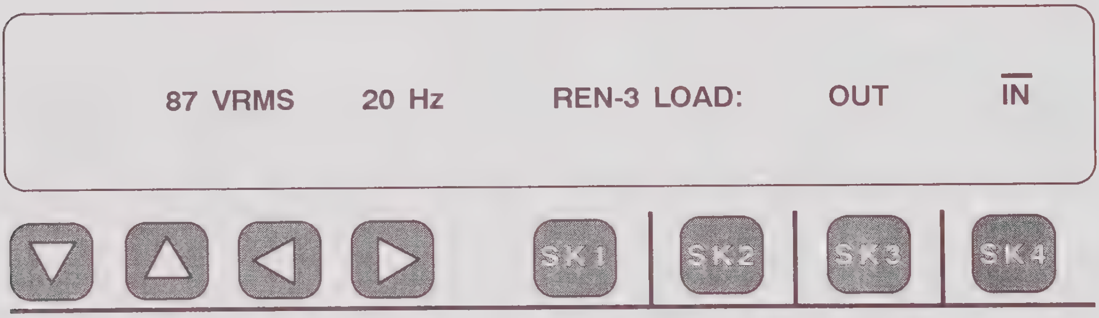

0 VRMS 0 Hz REN-3 LOAD: $\overline{\text{OUT}}$ IN

In this example, the **REN-3 Load** is not on line (as shown by the cursor above **OUT**). **To have the 930A act as a true REN-3 Load** at its TR or T1R1 jacks, press Softkey 1 (under **IN**). The 930A display will change to the one on the next page.



If you have selected a 4-wire Trunk Type, there is no display of the level and frequency of the Ringing.

When Ringing does come into the 930A on a 2-wire Trunk, the display will show the voltage level in RMS volts and the frequency in Hertz. A sample display is shown below:



The 930A must be providing the load to make these measurements.

You can leave Menu Option 5 at any time by pressing the **OPTION MENU** key or any other Function key. If you have selected **IN**, then the 930A will put a 3 Ringer Equivalent load on the line while you make other measurements. The default condition for this Menu Option is **OUT** or **off line**.

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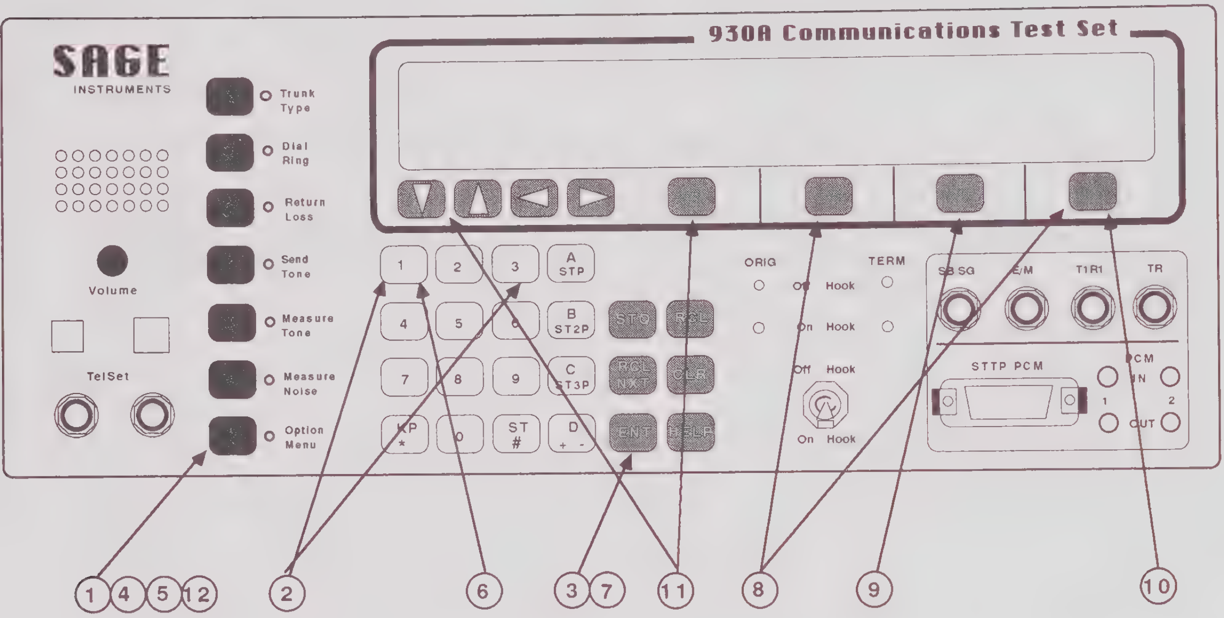


To select **Phase/Amplitude Jitter** measurement:

1. Press the **OPTION MENU** function key.
2. Use the numeric keypad to enter the number 13.
3. Press the **ENT** (Enter) key to begin Phase/Amplitude Jitter measurements.
4. Press the **OPTION MENU** Function key to stop measurements and exit.

To select **Phase Hits, Gain Hits and Dropouts** measurement:

5. Press the **OPTION MENU** function key.
6. Use the numeric keypad to enter the number 11.
7. Press the **ENT** (Enter) key to complete the numeric entry.
8. Press Softkey 2 (under **DEFAULT**) to select **DEFAULT** Impulse Noise and Hits parameter values, or press Softkey 4 (under **SET-UP**) to manually change individual parameters.
9. Press Softkey 3 (under **MEASURE**) to enter measurement mode.
10. Press Softkey 4 to start or stop measurements.
11. Press Softkey 1, or the **UP/DOWN** arrow keys, to toggle between Impulse and Hits measurements displays.
12. Press the **OPTION MENU** function key several times to exit.

PHASE/AMPLITUDE JITTER OPTION
FIGURE 4-8

4-8 PHASE/AMPLITUDE JITTER AND HITS (OPTION 930A-18)

Option 930A-18 works in conjunction with Option 930A-07 (Impulse Noise) to provide the capability to measure Phase and Amplitude Jitter on Voice Frequency channels as well as transient phenomena such as Phase Hits, Gain Hits, and Dropouts.

Since the Phase and Amplitude Jitter measurements are displayed under Option Menu 13 and the Hits are counted with Impulse Noise under Option Menu 11, this Section is divided into two parts: Section 4-8.1 deals with Jitter and Section 4-8.2 deals with Hits.

As always, you must **first** select the correct **Trunk Type** (Refer to Section 3-4) and connect the 930A to the trunk under test prior to setting up these measurements. In the case of Phase Jitter measurements however, **it is also necessary to perform a C-Message Noise measurement prior to measuring Phase Jitter. Excess noise can cause what appears to be significant amounts of jitter.**

4-8.1 TO MEASURE PHASE/AMPLITUDE JITTER (MENU OPTION 13)

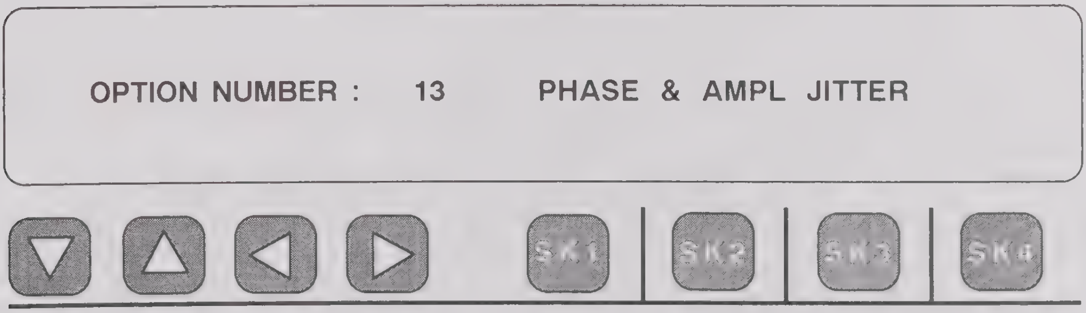
After making a C-Message noise test, as outlined in Section 3-9 (readings should be less than 20 dBrnC for quiet terminated line), do the following to select the Phase/Amplitude Jitter mode:

Press the OPTION MENU

function key.

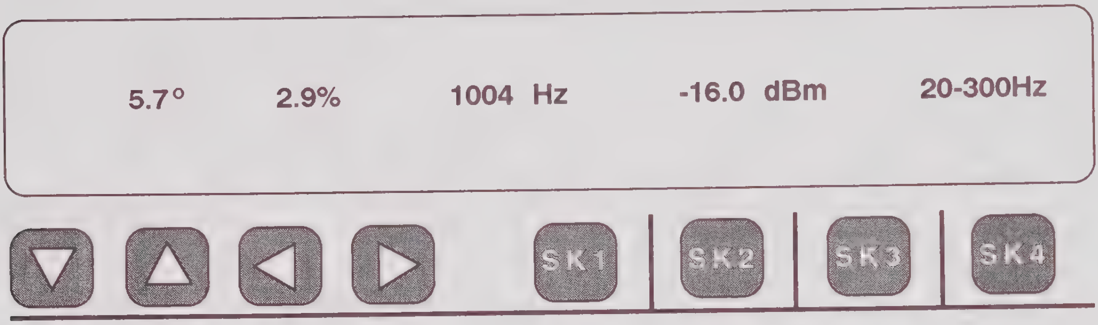
Use the UP/DOWN arrow keys to

select Menu Option 13: PHASE & AMPL JITTER.



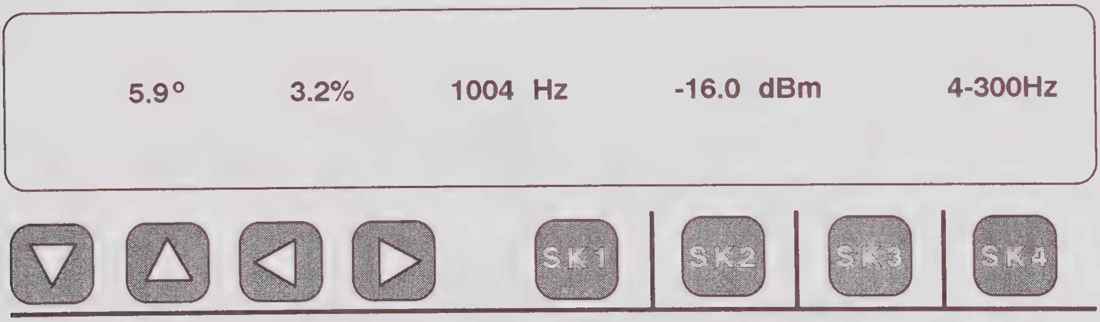
OPTION NUMBER : 13 PHASE & AMPL JITTER

Press any softkey under the display to immediately begin measurements:



The 930A begins measuring Phase and Amplitude Jitter over the filter bandwidth of 20 Hz to 300 Hz. It also displays the level and frequency of the received holding tone (usually 1004 Hz).

There is a good deal of phase jitter on the trunk in this example. The full jitter measurement bandwidth (**4-300 Hz**) provides an overall picture of the jitter situation. **The next step** is to try to determine the source of the jitter. **Press Softkey 4** (under **20-300 Hz**) to change the filter bandwidth selection from **20-300 Hz** to **4-300 Hz.** Assume that the 930A displays the following measurements:

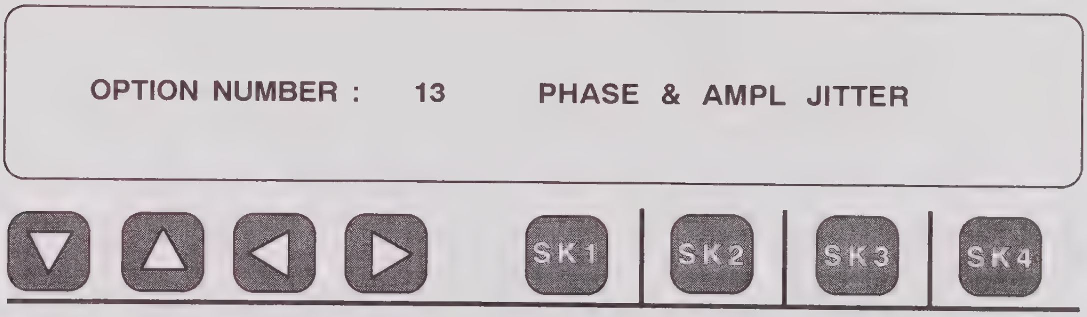


In this case, there is not significant change in either the 4-300 Hz or 20-300 Hz band readings. The interpretation of these results is relatively straightforward now that the measurements have been made. The fact that the readings are relatively the same suggests that the source of the excess jitter has a fundamental frequency above 20 Hz since there are no significant contributions to the levels from below 20 Hz.

Between 20 Hz and 300 Hz the most significant source of jitter is the 60 Hz AC power line frequency and its second through fifth harmonics (120 Hz, 180 Hz, 240 Hz, 300 Hz).

There is a good chance that making the C-Message Noise test prior to the Jitter test would also have provided a tip-off to the problem. Since the Model 930A has a frequency response down to 50 Hz (20 Hz on PCM trunks), it is also possible that you could determine the exact frequency of the jitter source by simply pressing the **MEASURE TONE** key and noting the displayed frequency value when the holding tone is removed. If the jitter source is of sufficient amplitude, it will be displayed. If not, then you must assume that the source is 60 Hz, or a harmonic of 60 Hz, and proceed to troubleshoot on that assumption.

To stop testing and return to the main menu, press the **OPTION MENU** key. The 930A display will return to:


OPTION NUMBER : 13 PHASE & AMPL JITTER

4-8.2 PHASE HITS, GAIN HITS AND DROPOUTS (MENU OPTION 11)

The measurement of the transients known as Phase Hits, Gain Hits, and Dropouts requires that Option 930A-07 (3-Level Impulse Noise) be installed in the 930A as well as Option 930A-18. These measurements are performed in conjunction with Impulse Noise measurement and are displayed as a sub-menu of the Impulse Noise display.

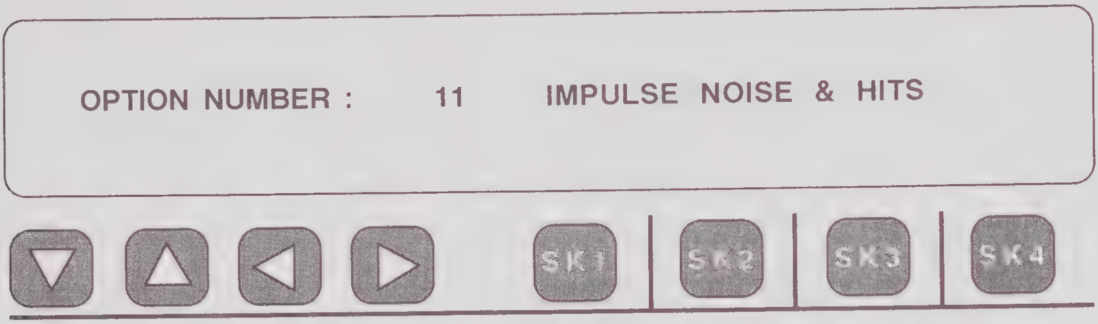
To begin testing perform the following steps:

Press the OPTION MENU function key.

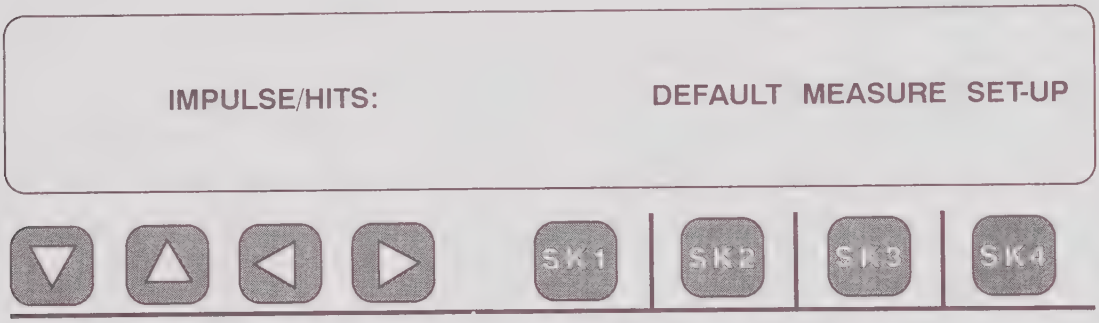
Use the UP/DOWN arrow keys to

select Menu Option 11: IMPULSE NOISE & HITS.

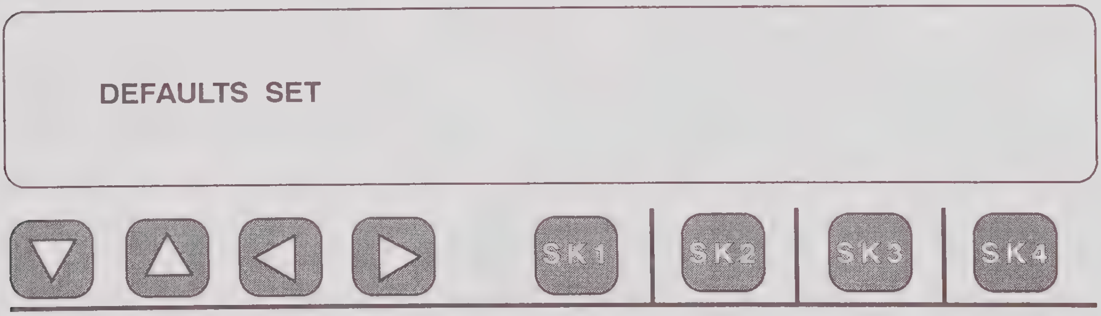
The Model 930A display will appear as:


OPTION NUMBER : 11 IMPULSE NOISE & HITS

Press any softkey under the display and it will become:


IMPULSE/HITS: DEFAULT MEASURE SET-UP

Softkey 2 (under **DEFAULT**) sets all the test parameters such as thresholds and time intervals to the factory defaults for the **TRUNK TYPE** selected. Pressing Softkey 2 causes the 930A to momentarily display the message:

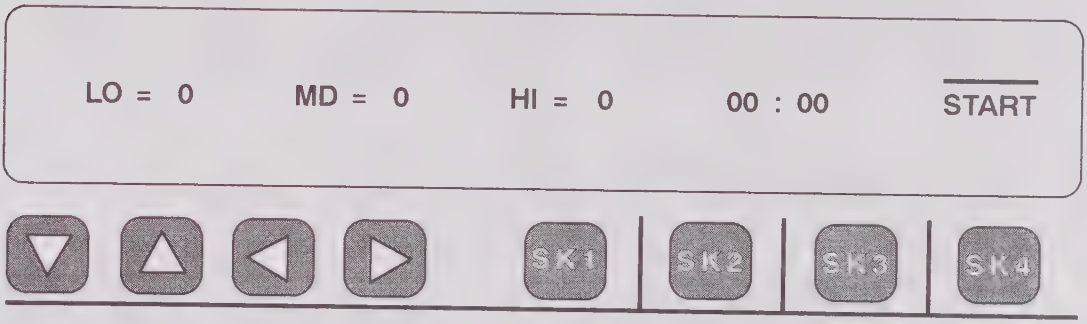

DEFAULTS SET

This also provides a convenient way to restore previously entered settings to the factory default values.

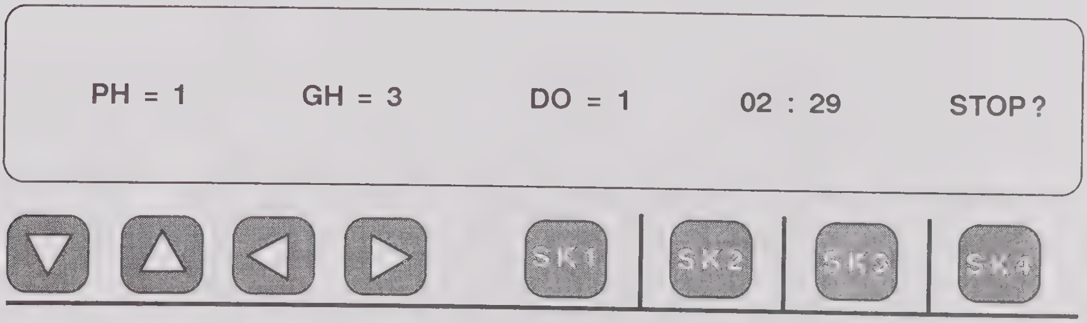
The factory defaults are:

C-Notch filter for measurement with holding tone
Low Impulse Threshold is 54 dBrnC (Analog trunks)
Low Impulse Threshold is 67 dBrnC (T-Carrier trunks)
Spread between thresholds is 4 dB
Measurements per second is 7
Phase Hit threshold is 20°
Gain Hit threshold is 3 dB
Test Duration is 15 minutes

At this point, press Softkey 3 (under **MEASURE**) to enter the measurement mode and the display will appear as shown below:



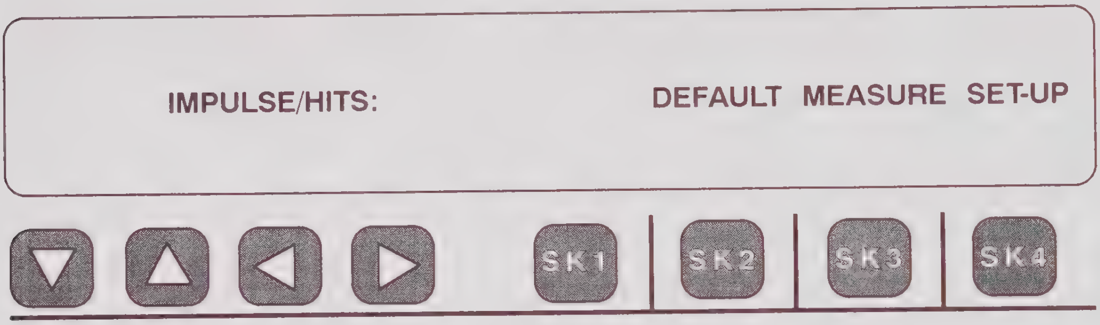
Press Softkey 4 (under **START**) to begin measuring Impulse Noise and Hits. To see the Hits measurements, press Softkey 1, any of the arrow keys, or Softkeys 2 or 3, and the display will toggle between Impulse Noise and Hits. For example, the Hits display might appear as shown below:



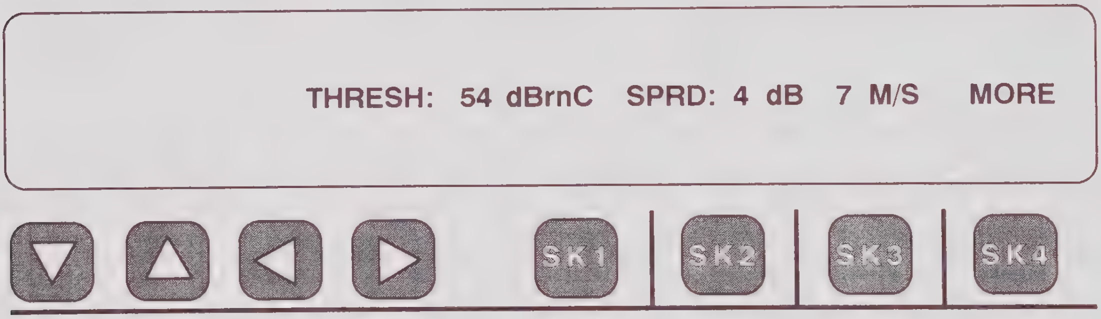
This is the easy way to make measurements of Hits and Impulse Noise.

4-8.3 HOW TO CHANGE THE DEFAULT SETTINGS

Some users may need to set one or more of the parameters individually. This is where it becomes necessary to enter the **SET-UP** mode. **The Set-Up procedure** for the Impulse Noise Parameters (Low Threshold, Spread, Measurements per Second and Measurement Time) is described in detail in Section 4-5. The main display is repeated below:

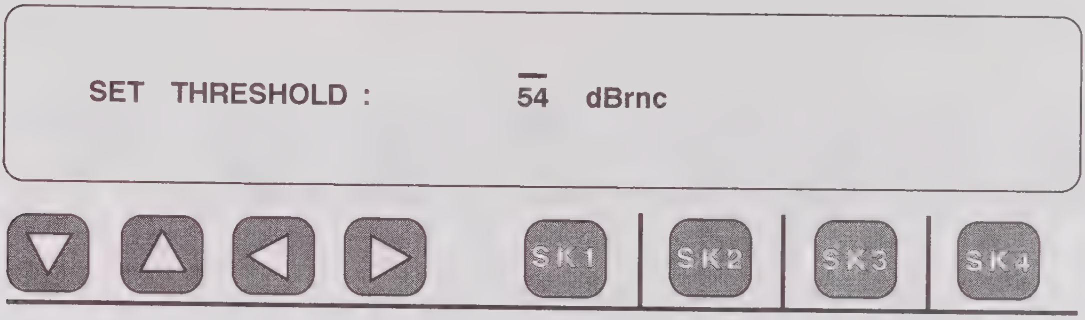


Instead of pressing Softkey 2 to set all the parameters at once, pressing Softkey 4 (under **SET-UP**) causes the following display to appear:



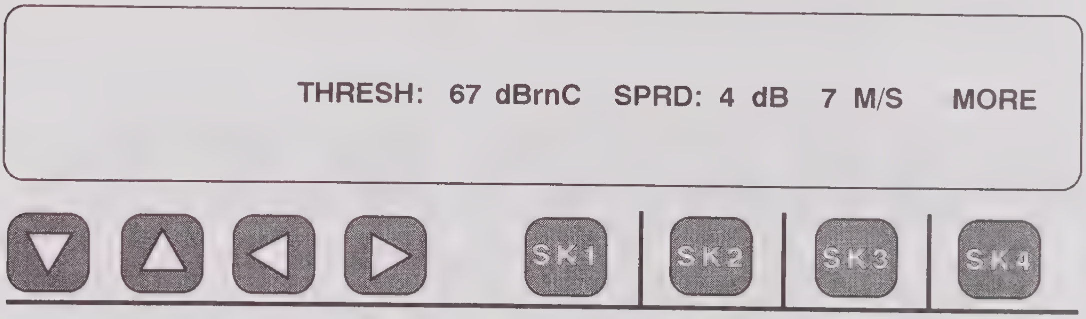
The Set-Up of the Impulse Noise and transient (**HITS**) parameters consists of selecting the Low Impulse Threshold, Phase Hit and Gain Hit thresholds and test duration. For example purposes, suppose that a portion of the end- to-end circuit being tested is carried on T-Carrier facility and part is on analog facility. Since this is a mixed circuit the low threshold should be set to 67 dBrnC.

Press Softkey 1 (under **THRESH: 54 dBrnC**) in the previous display and the 930A display will change to:



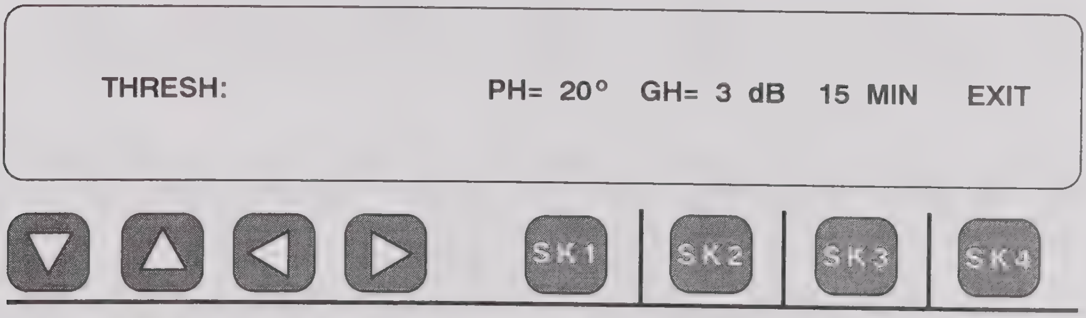
SET THRESHOLD : $\overline{5}4$ dBrnc

To change this value to 67 dBrnC, press **6** and **7** on the keypad, and press the **ENTER** key. The 930A display will now show:

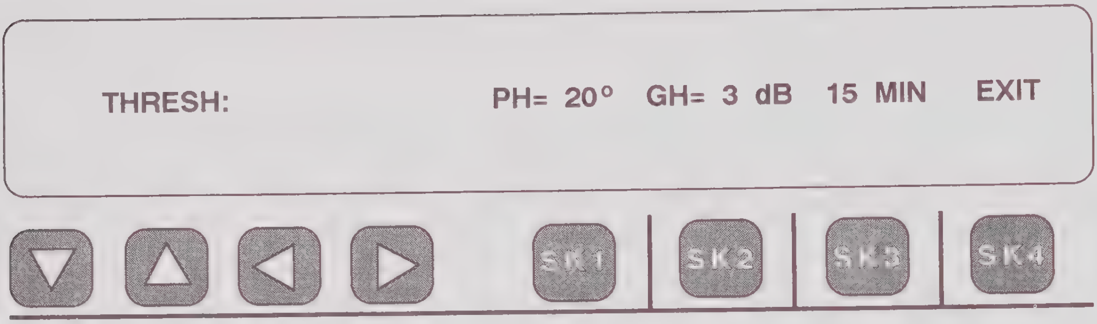


THRESH: 67 dBrnC SPRD: 4 dB 7 M/S MORE

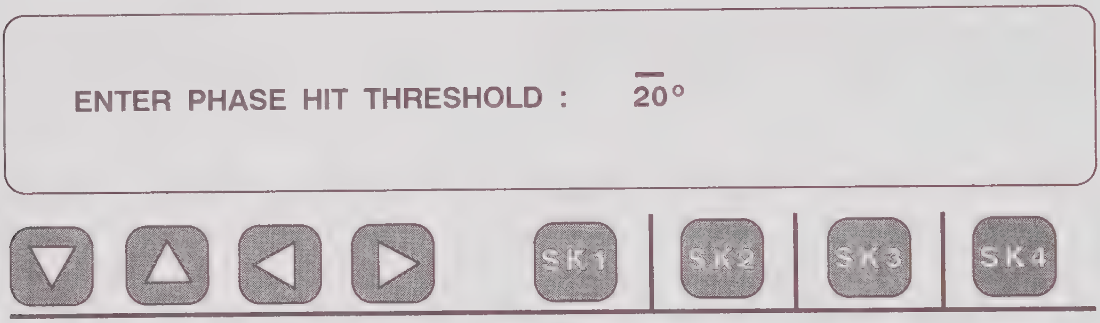
Now the low threshold would be 67 dBrnC, and since the spread is set at 4 dB, the medium threshold would be 71 dBrnC, and the high threshold would be 75 dBrnC. The 4 dB spread and 7 measurements per second are the standards, but they can be changed in the same manner as the low threshold, by pressing the softkeys under them and entering the change. In this Section we are concerned with setting up the Transient or Hits thresholds, so press Softkey 4 (under **MORE**) and the 930A display becomes:



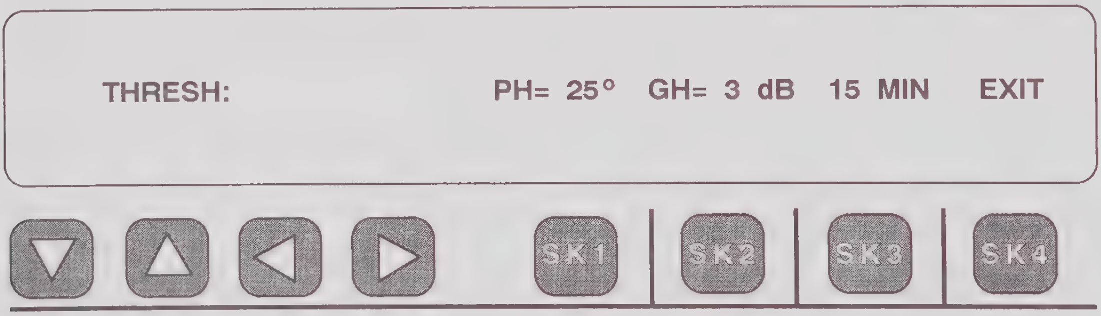
THRESH: PH= 20° GH= 3 dB 15 MIN EXIT



Suppose you want to change the Phase Hit threshold to 25° instead of using the default value of 20°. Press Softkey 1 (under **PH = 20°**) and the 930A display will change to:

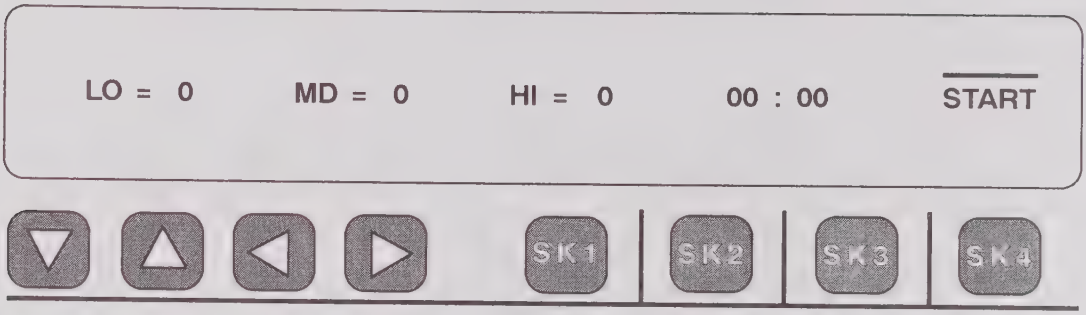


You can now enter any value between 1° and 45°. Then pressing the **ENT** (Enter) key completes the data entry. The display will return to the Set-Up menu with the new value of Phase Hit threshold entered. To set a 25° threshold, press **2** and then **5** and then the **ENTER** key. The display becomes:

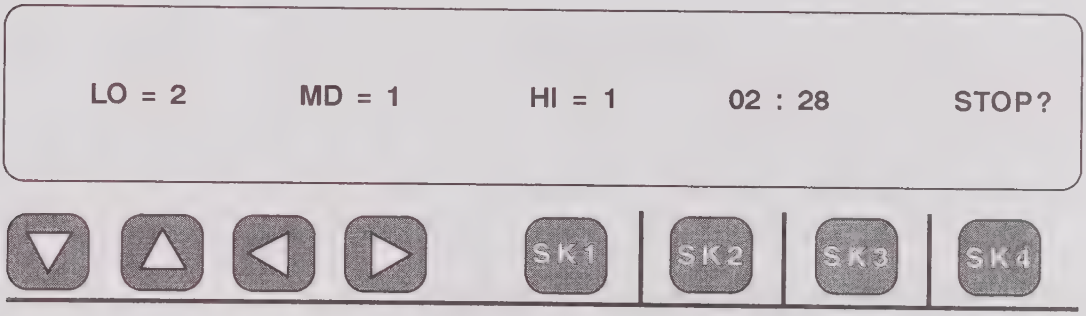


Similarly, the Gain Hit threshold and Test duration can be changed by pressing Softkey 2 (under **GH= 3dB**), or Softkey 3 (under **15 MIN**). Pressing Softkey 4 (under **EXIT**) returns the 930A to the main menu to begin testing.

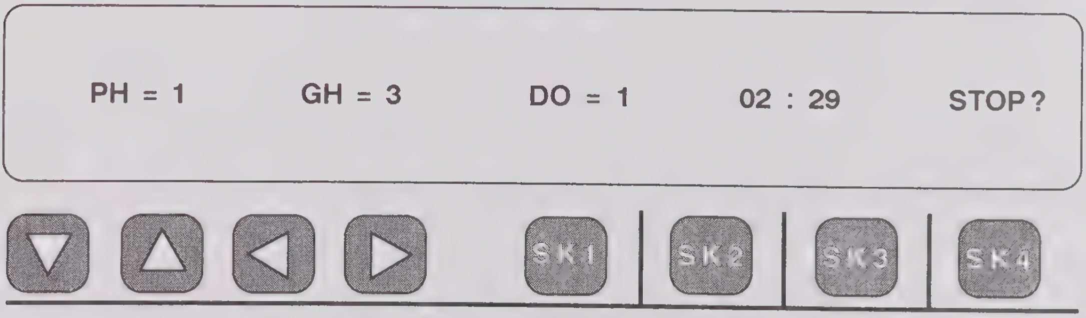
The 930A measurement display appears as:


LO = 0 MD = 0 HI = 0 00 : 00 START

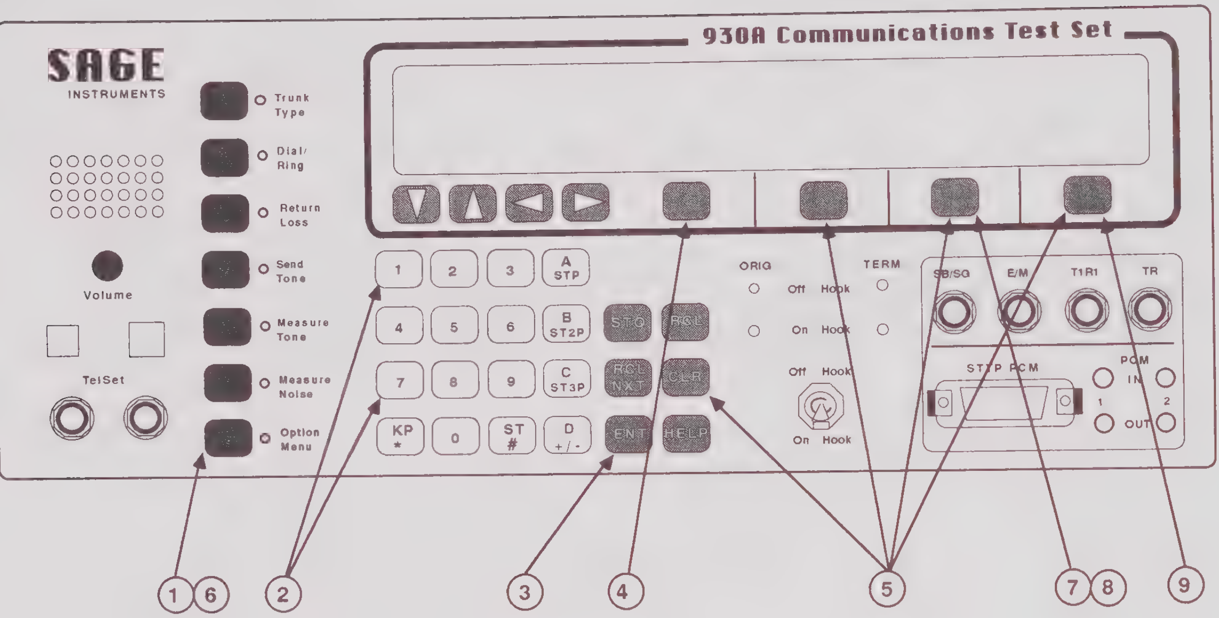
Press Softkey 4 (under **START**) and the 930A will begin measuring Impulse Noise and Hits. After a time, a typical display would appear as shown below:


LO = 2 MD = 1 HI = 1 02 : 28 STOP?

Pressing Softkey 1, or the **UP/DOWN** arrow keys, toggles between displays of Impulse Noise counts and Hits. A typical display of the Hits counters is:


PH = 1 GH = 3 DO = 1 02 : 29 STOP?

Pressing Softkey 4 (under **STOP?**) will stop the measurement at any point. Otherwise, the 930A will count events until the test time (usually 15 minutes) has elapsed. The 930A will retain the values shown on the counters until a new test is started by again pressing Softkey 4.



To select **Envelope Delay Distortion** measurement:

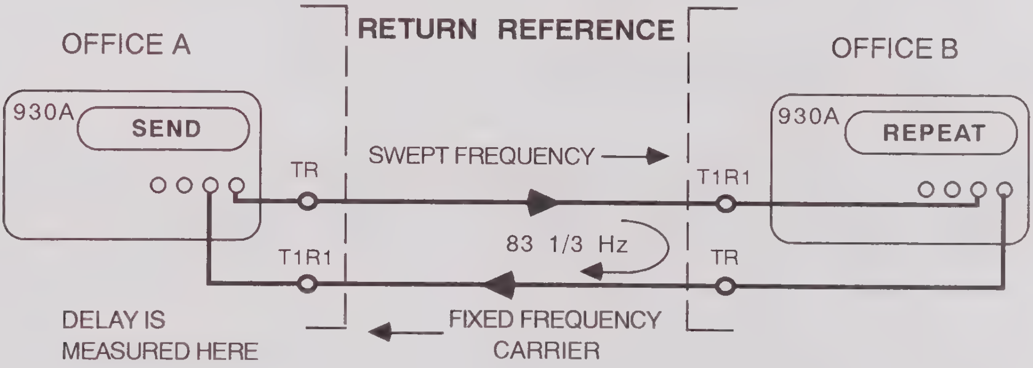
1. Press the **OPTION MENU** function key.
2. Use the numeric keypad to enter the number 17.
3. Press the **ENT** (Enter) key to enter the **SELECT** menu.
4. To change the test set-up parameters, press Softkey 1.
5. Press Softkey 2 to enter the **SEND** or Master mode.
   Press Softkey 4 to set the zero reference delay.
   Press Softkey 4 again to begin frequency sweep.
   Press Softkey 4 again to stop the sweep.
   Press the **CLR** key to set the zero reference at another point, if desired.
   Press Softkey 3 to toggle between send and receive displays.
6. Press the **OPTION MENU** key to exit to the **SELECT** menu.
7. Press Softkey 3 to enter the **REPEAT** or Slave mode.
8. Press Softkey 3 to toggle between send and receive.
9. Press Softkey 4 to start or stop sweep.

ENVELOPE DELAY DISTORTION
FIGURE 4-9

4-9 ENVELOPE DELAY DISTORTION (OPTION 930A-19)

Envelope Delay Distortion (EDD) is always an end-to-end test. It requires test sets at both ends of the circuit and a 4-wire transmission path. One end is set up in the **REPEAT** (or Slave) mode. The other end is set up in **SEND** (or Master) mode. The **SEND** unit transmits a single frequency (usually 1804 Hz) to establish a reference delay. This delay is "zeroed out", and the **SEND** unit sends a frequency sweep, measuring delay in microseconds relative to the reference. Then the **SEND** end transmits the reference frequency while the **REPEAT** end sweeps the returned carrier. All delay measurements are made at the **SEND** end. These tests are often referred to as **RETURN REFERENCE** and **FORWARD REFERENCE** measurements.

The measurement proceeds as shown below:

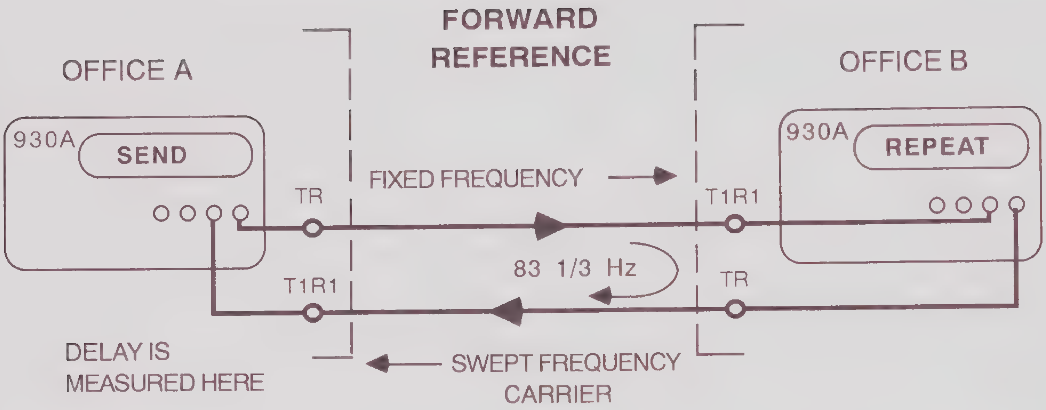


1) Office A sends an amplitude-modulated signal over the trunk under test.

2) Office B strips off the modulation and applies it to a carrier.

3) Office A recovers the returned modulation and compares it to that being sent. The difference in phase is proportional to the envelope delay.

4) The delay at a reference frequency is used as a zero reference, and a frequency sweep is then performed by the **SEND** unit. The delay at the other frequencies is measured in microseconds relative to the reference.



5) The **SEND** unit sends the reference frequency while the **REPEAT** unit sweeps the returned carrier. This allows the **SEND** unit to measure the delay on the return path.

4-9.1 MEASURING ENVELOPE DELAY DISTORTION (MENU OPTION 17)

To make an Envelope Delay measurement, perform the following steps:

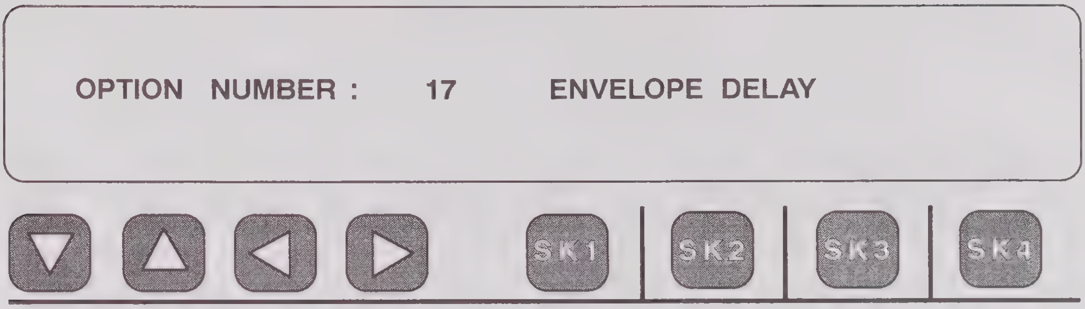
Make sure that the 930A at each end of the circuit is set to the correct Trunk Type and impedance (Refer to Section 3-4). Use the **DIAL/RING** function to place a call over the trunk under test. With both units off hook in the **DIAL/RING** function, a voice path is available through the front panel Tel-Set jacks. A handset can be connected to allow coordinating the test activities with the far-end if a separate voice path is not available. Decide at this point which unit will be the **SEND** end, and which will be the **REPEAT** end.

Press the OPTION MENU ■ ○ **Option Menu** function key.

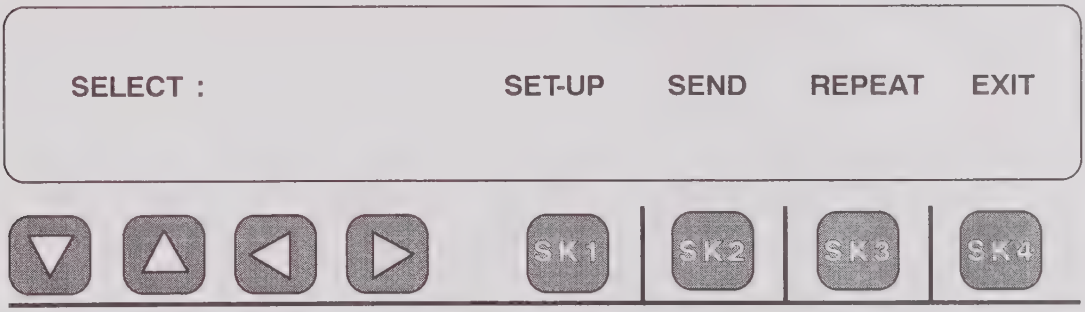
Use the UP/DOWN ▽ △ arrow keys to

select Menu Option 17: ENVELOPE DELAY.

The Model 930A display will appear as shown below:



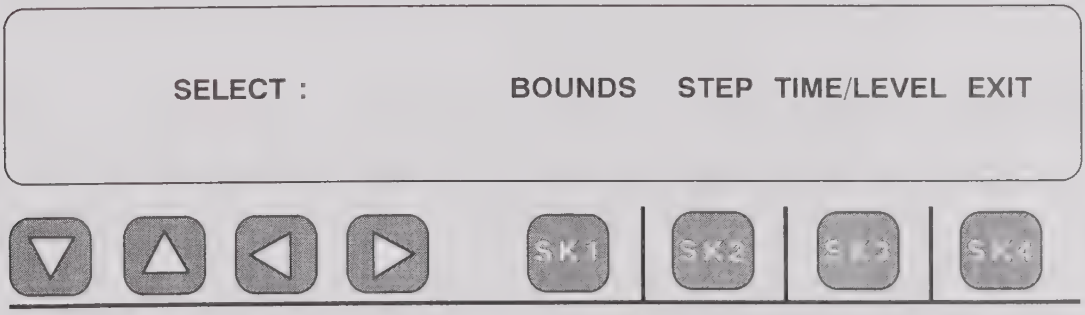
To enter the menu, press any softkey and the 930A display will change to the display below:



At this point, you can change any, or all, of the test parameters, or go directly to the measurement mode. If the test set-ups have been previously entered, and have not been changed, it is not necessary to re-enter the set-up mode. The 930A remembers the test set-ups.

SETTING UP A SWEEP:

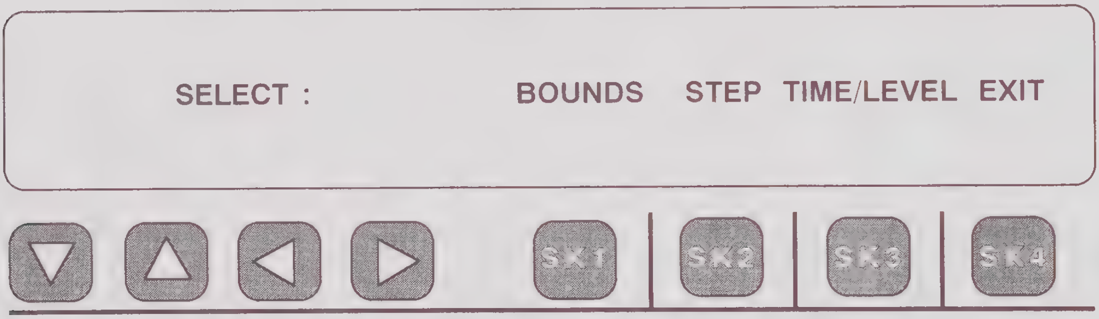
To enter the Set-Up menu, press Softkey 1 (under **SET-UP**) and the display will change to:



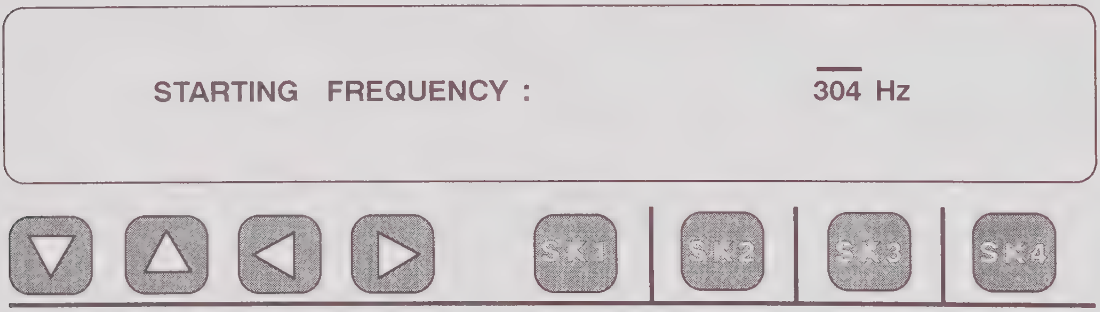
The 930A default parameters have been pre-set to sweep from 304 Hz to 3204 Hz in 100 Hz steps at a level of -16 dBm and a time between steps of 3.5 seconds with the SF frequency band skipped. A typical Envelope Delay measurement would use these default settings. You **do not** need to enter the **SET-UP** menu unless you want to change these settings.

Some C-Conditioned line tariffs specify performance out to 3504 Hz. Also, older vintage test equipment operated at 5 seconds between steps and it is possible that a different test set than the 930A may be at the far end of the circuit. For these reasons it is good to know how to change the test set-ups.

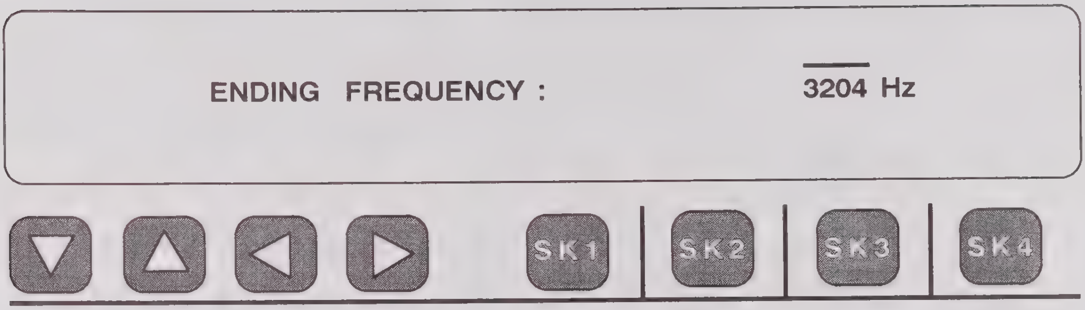
To change the ending frequency bound from the 3204 Hz default value to 3504 Hz return to the **SELECT** display repeated below:



Pressing Softkey 1 (under **BOUNDS**) will bring up the following display:

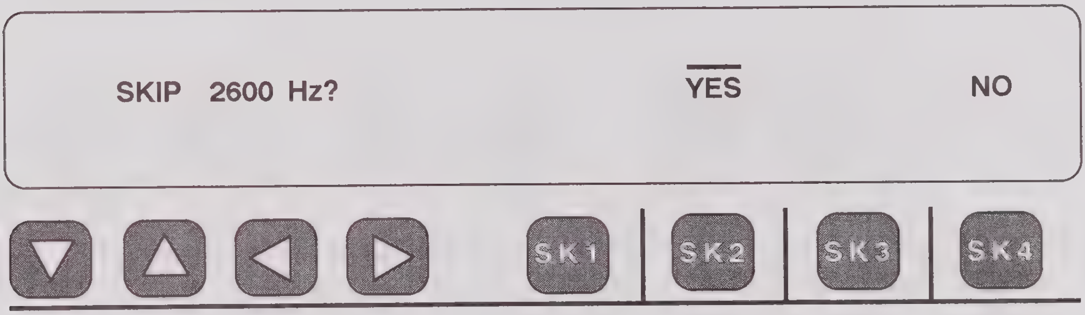


Press Softkey 3 (under **304 Hz**) to keep this value for our example. The display will advance to the next choice.



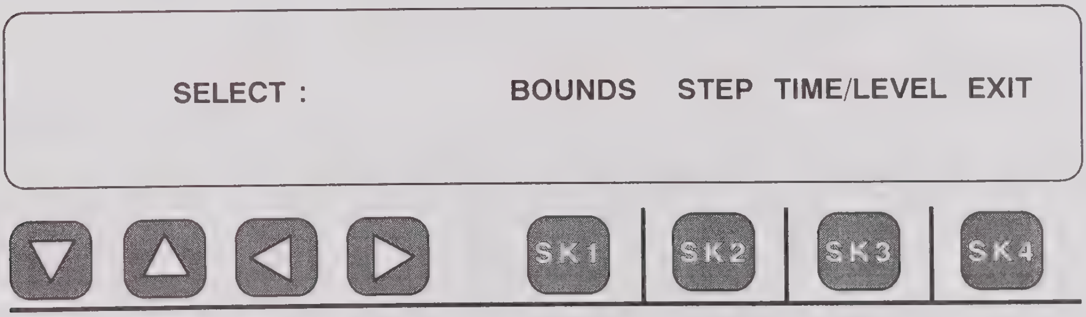
ENDING FREQUENCY : 3204 Hz

This value is to be changed to 3504 Hz. Press **3, 5, 0** and **4** on the numeric keypad and press the **ENTER** key. The 930A will advance to the **Skip SF** display below:



SKIP 2600 Hz? YES NO

Press Softkey 2 to **SKIP SF**. The 930A will return to the **SELECT** display repeated below:

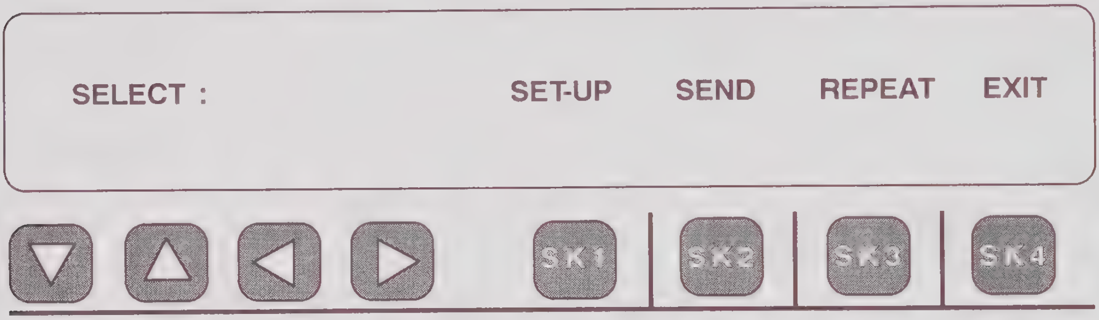


SELECT : BOUNDS STEP TIME/LEVEL EXIT

You can change the step size from 100 Hz to any value between 1 and 999 Hz. The time between steps can be changed from 3.5 seconds to any value between 0.1 and 9.9 seconds. The level may be changed from -16.0 dBm to any value between 0 and -40 dBm. The procedure is the same.

Since this menu is taken directly from Menu Option 10: FREQUENCY SWEEP, levels may be entered from +12.0 dBm to -60.0 dBm and they will appear to be accepted. However, the 930A will only transmit over the 0 dBm to -40.0 dBm range allowed in Envelope Delay Distortion measurements.

Press Softkey 4 (under **EXIT**) when the sweep parameters have been set to the desired specifications. This returns the 930A to the main **EDD** selection display:



Again, once the 930A has been set up, it is not necessary to enter the set-up menu to start testing.

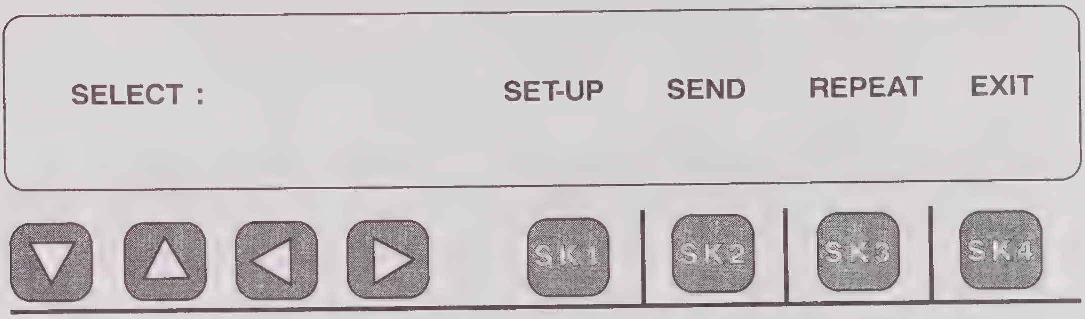
Envelope Delay Distortion is an end-to-end measurement with test sets located at each end of the trunk under test. Provided the test sets meet the requirements of AT&T Pub 41009, or IEEE Specification 743-1984, it is not necessary to have the same manufacturer's set at both ends for manual testing.

However, different manufacturers refer to the same tests by different names. **Return Reference mode** could be called the **Master** or **Send mode**, while the **Repeat mode** may be referred to as **Re-Mod**, or **Re-Modulating mode,** or **Slave mode**. The 930A has two modes for simplicity: **SEND** and **REPEAT**. Forward Reference, Return Reference and Repeat mode testing can all be performed by the 930A.

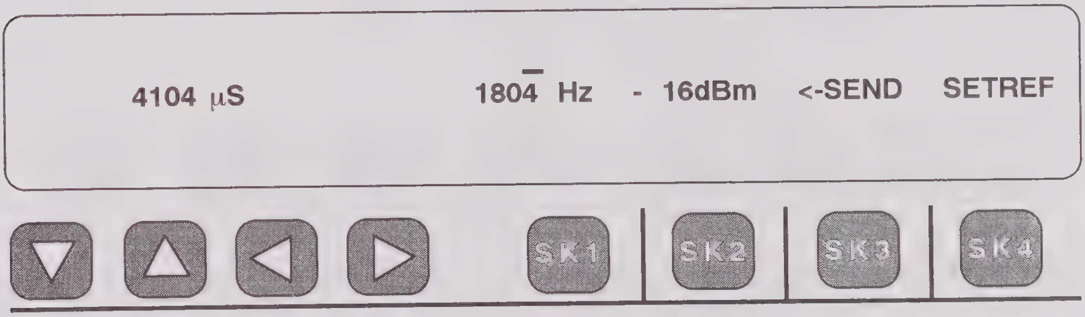
REMEMBER: One test set must be in the SEND, or MASTER, mode while the set at the other end must be in the REPEAT, or SLAVE, mode. Diagrams of test set-ups appear on pages 4-135 and 4-136.

The following sections explain the operation of the 930A when performing **EDD** measurements.

4-9.2 EDD MEASUREMENT IN THE SEND MODE



Starting from the main EDD selection display shown above, press Softkey 2 (under **SEND**) and a display similar to the following will appear:



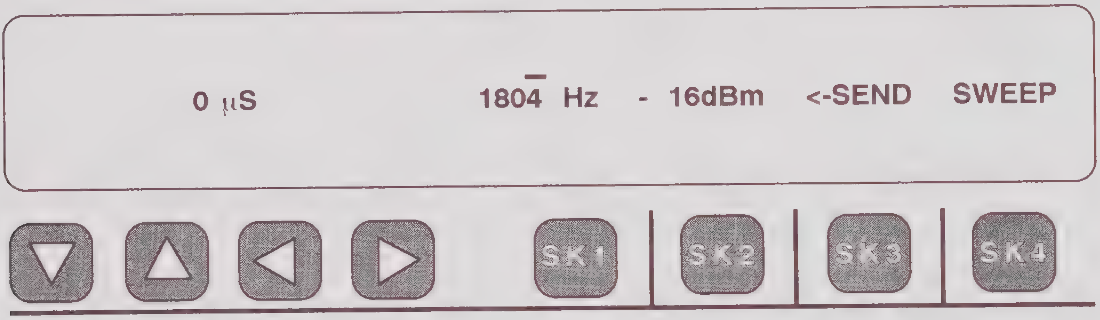
This display shows the calculated phase delay in microseconds for the return reference signal from the **REPEAT**, or **SLAVE**, unit and the level and frequency of the signal being sent from the **SEND**, or **MASTER**, unit. The usual reference (**FORWARD** or **RETURN**) signal is an 1804 Hz carrier at -16 dBm as shown above.

All measurements of **EDD** are made at the **SEND**, or **MASTER**, end of the circuit. **EDD** is also a referenced measurement. The first thing the 930A does when it enters the **SEND** mode is ask you to set the reference.

To change the reference frequency, press Softkey 1 (under the frequency). A highlighted cursor will appear over the last digit of the frequency (the "**4**" in this case) as shown above. Enter a new frequency using the keypad. Press the **ENT** key, or any softkey, to complete the entry. Only frequencies between 304 Hz and 3504 Hz are valid for this test.

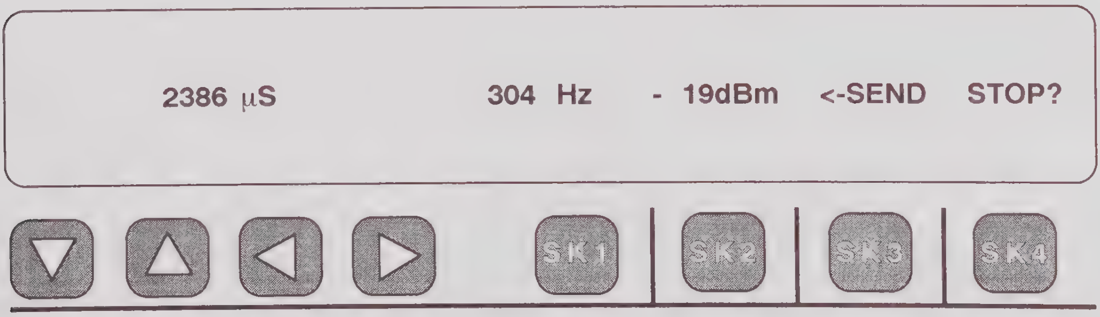
To change the level, press Softkey 2 (under the level). A highlighted cursor will appear over the last digit of the level. Enter the new level using the keypad. Press **ENTER**, or any softkey, to complete the entry. Only levels between 0 dBm and -40 dBm are valid for **EDD** measurements.

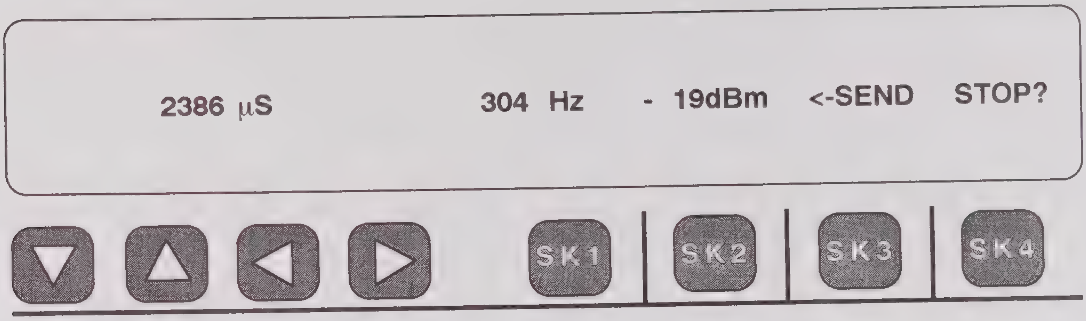
To set the reference delay, press Softkey 4 (under **SETREF**) after allowing the delay reading to stabilize for a few seconds. The current envelope delay reading will become the reference and all subsequent measurements will be relative to this reference. This effectively "zeroes out" the current measurement. Again, the normal convention is to "zero" the delay measured at 1804 Hz. The display should resemble that shown below.



Once a reference has been established, the frequency or level of the outgoing reference signal can be changed or the frequency sweep can be generated. **To re-zero the reference without leaving the SEND mode**, press the **CLR** key. The current measurement will become the new zero reference.

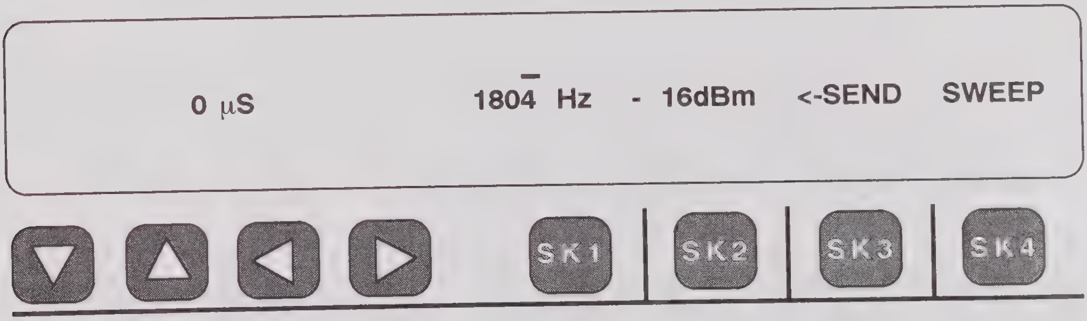
To send a sweep and perform a Return Reference measurement after setting the reference delay, press Softkey 4 (now under **SWEEP**). The 930A display will now resemble the display shown below:





The sweep parameters which were set up earlier will automatically begin. The delay will be measured and displayed for each frequency in the sweep. If a terminal or 80 column printer is attached, and the 930A is in **PRINTER** remote mode (Requires Option 930A-10C), the 930A will automatically print the delay at each frequency of the sweep (Refer to Section 5-2 for Printer set-up details). **To interrupt the sweep**, without leaving the **SEND** mode, press Softkey 4 (now under **STOP?**) in the above display.

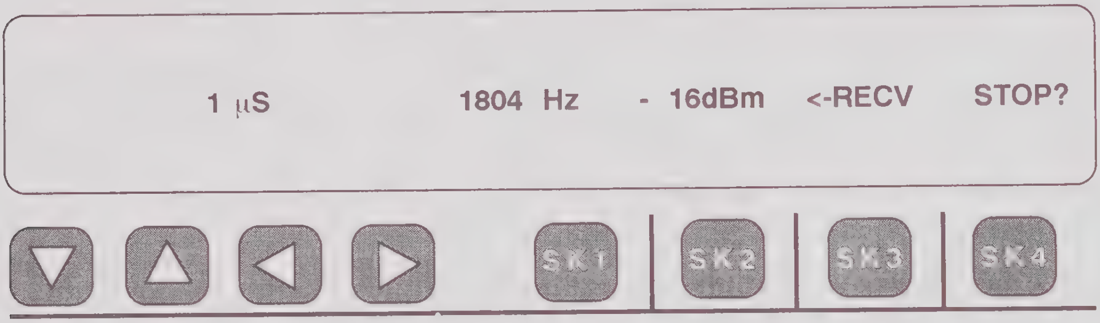
When the sweep completes, or is interrupted, the 930A will revert to sending the reference frequency. Softkey 4 will again be labeled **"SWEEP"** as shown below:



The sweep can be repeated or you can manually set the frequency of the signal to examine the delay at frequencies of interest.

When all of the measurements are complete, the operator at the near, or **SEND**, end can alert the operator at the far end to sweep the return carrier. This will allow a **Forward Reference** measurement to be made of the return path delay. The **SEND** unit transmits the fixed reference signal toward the **REPEAT**, or Slave, unit at the far end.

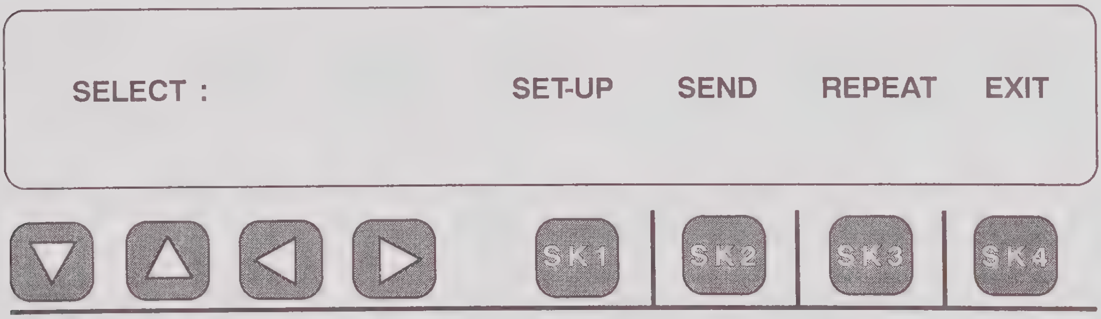
To examine the level and frequency of the returned carrier, press Softkey 3 (under **<-SEND**). The received level and frequency will be displayed and the label above Softkey 3 will change to read "**<-RECV**". You can toggle between viewing the outgoing signal or the returned carrier at any time. This is especially useful when the far-end is sweeping the returned carrier. An example display of the returned reference carrier while sweeping from the **SEND** unit is shown below:



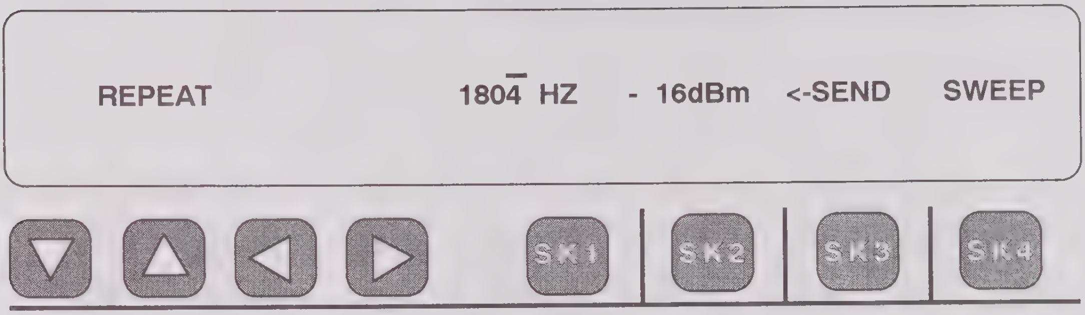
The carrier level should be within the 0 dBm to -40 dBm range and steady for the test to be valid.

4-9.3 EDD MEASUREMENT IN THE REPEAT OR SLAVE MODE

Once the near end 930A has been set up for the **SEND** mode, the 930A at the other end of the circuit must be set to the **REPEAT** mode. The main **EDD** selection display is repeated below:



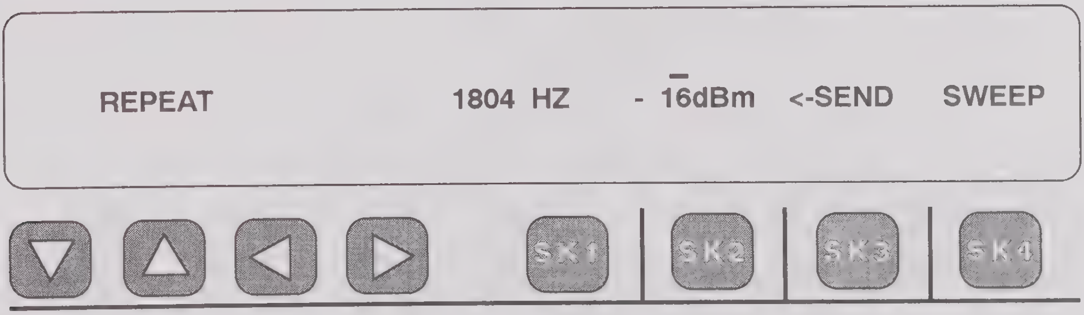
To place a 930A in the REPEAT, or Slave mode, press Softkey 3 (under **REPEAT**) and the display on the following page will appear.



This display shows the level and frequency of the carrier tone that is being used to return the amplitude modulation to the **SEND** unit. The default value is 1804 Hz at -16 dBm.

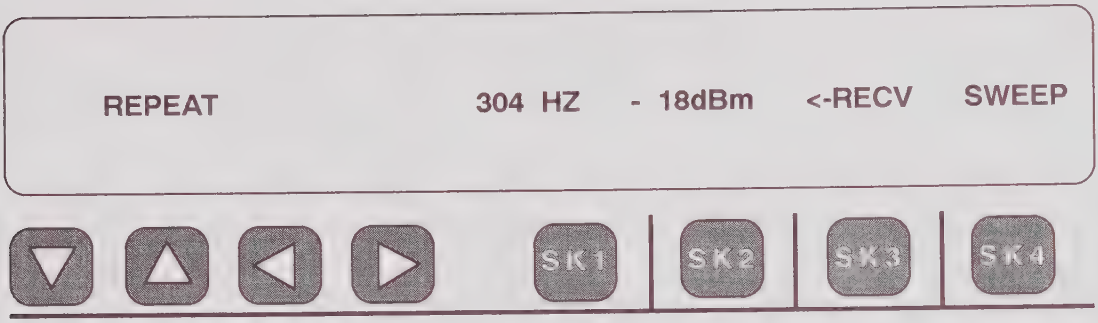
To change the frequency of the carrier, press Softkey 1 (under the frequency). A highlighted cursor will appear over the last digit of the frequency, as shown above. Use the keypad to enter the new frequency. Press the **ENT** key, or any softkey, to complete the entry. Only frequencies from 304 Hz to 3504 Hz are valid carriers for this test.

To change the level of the carrier, press Softkey 2 (under the level). A highlighted cursor will appear over the last digit of the level, as shown below:



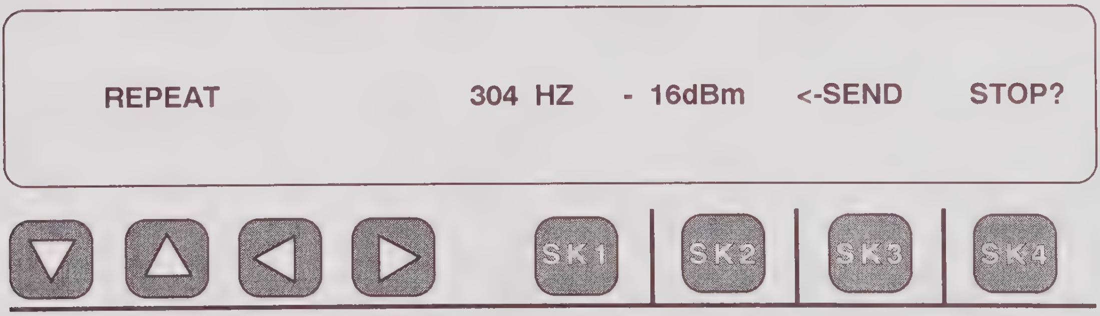
Use the numeric keypad to enter a new level. Press **ENT**, or any softkey, to complete the entry. Only levels from 0 dBm to -40 dBm are valid for this test.

To examine the level and frequency of the signal being received, press Softkey 3 (under **<-SEND**) and the display will change to that shown on the following page.



This shows the level and frequency of the signal being sent to the **REPEAT** unit from the **SEND** unit. The level must be between 0 dBm and -40 dBm for the test to be valid. Generally, this display would show a signal of 1804 Hz while the **SEND** end established a reference. This would be followed by a sweep from 304 Hz to 3204 Hz. When the sweep completes, the **Return Reference** part of the measurement is over. Then it is the turn of the **REPEAT** unit to sweep for the **Forward Reference** test. You can toggle between the received signal and the returned carrier by pressing Softkey 3 (under **<-SEND** or **<-RECV**).

To sweep the returned carrier for a Forward Reference measurement, press Softkey 4 (under **SWEEP**) and the 930A display will change to:



The 930A will begin to sweep the returned carrier through the frequencies that were selected previously. To interrupt the sweep, without leaving the **REPEAT** mode, press Softkey 4 (now under **STOP?**). When the sweep completes, or is interrupted, the 930A will revert to sending the reference frequency. Softkey 4 will once again be labeled **"SWEEP"**.

Press the **OPTION MENU** key when testing is complete and the 930A will return to the main **EDD** selection display. You can **exit** by pressing Softkey 4 (under **EXIT**).

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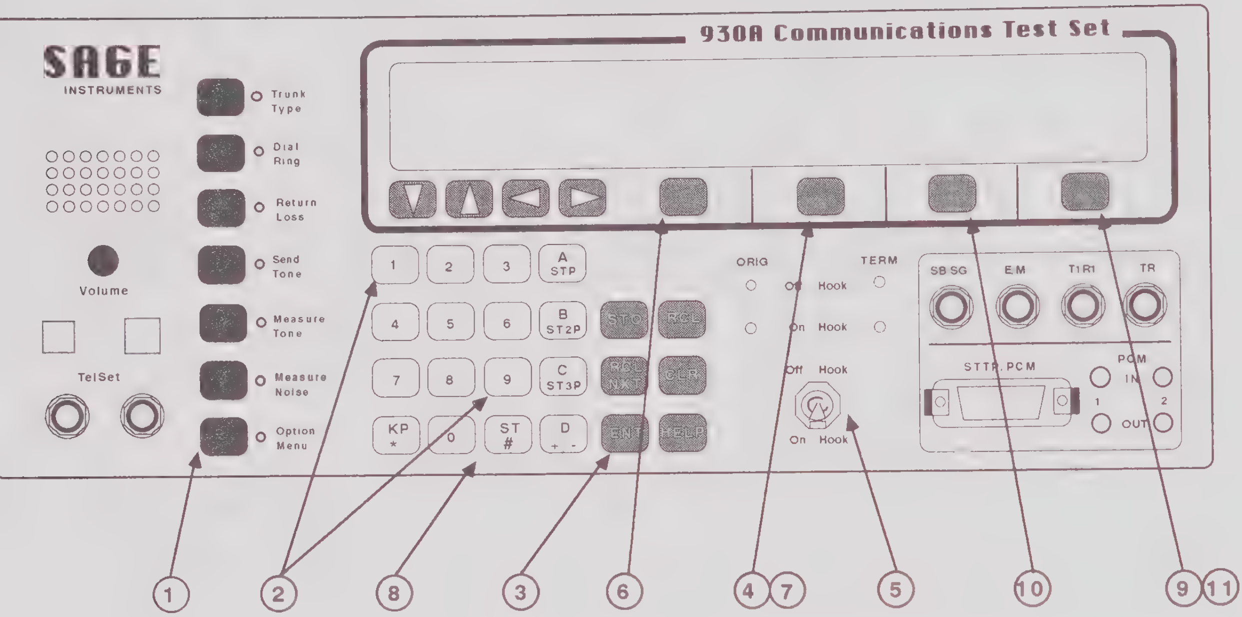


To select the **4-Tone Intermodulation Distortion** measurement:

1. Press the **OPTION MENU** Function key.
2. Use the numeric keypad to enter the number 19.
3. Press the **ENT** (Enter) key to complete the numeric entry.
4. Press Softkey 2 (under **SEND**) to adjust the transmit level, to select Signal-to-Noise test tones, or send the 4 tones over a 2-wire circuit.
5. Ensure that the 930A is **OFF HOOK** before trying to send test tones.
6. Press Softkey 1 to select **Signal-to-Noise**.
7. Press Softkey 2 to **send the 4-tones**.
8. Use the numeric keypad to enter new send levels.
9. Press Softkey 4 (**EXIT**) to get back to the main **IMD** menu.
10. Press Softkey 3 (under **MEASURE**) to measure signals on the line (This does not disable tones being sent under the **SEND** sub-menu in step 4 above).
11. Press Softkey 4 to **exit** from the menu and stop the test.

4-TONE INTERMODULATION DISTORTION
FIGURE 4-10

4-10 INTERMODULATION DISTORTION (OPTION 930A-20)

Intermodulation Distortion (IMD) measures the second- and third-order distortion products created in a non-linear circuit in the presence of a four tone signal.*

Intermodulation Distortion, sometimes referred to as Non-Linear Distortion, or 4-Tone Intermod, is an end-to-end measurement. That is, one test set sends the tone pairs at 857 Hz, 863 Hz and 1372 Hz, 1388 Hz while the other set has it's receiver looking at a band of frequencies centered around 520 Hz, 2240 Hz and 1900 Hz. The energy received in these filters constitutes the energy in the second- and third-order **IMD** products. **On 4-wire circuits**, a loopback can be inserted at the distant end so that one set may send and receive. On a 2-wire circuit, two sets are required, with one set either sending, or receiving, in turn.

Before testing, the user must select the appropriate Trunk Type (Refer to Section 3-4) and connect the 930A to the circuit. Once this has been accomplished, perform the following steps to place the 930A in the Intermodulation Distortion measurement mode:

Press the Option Menu ● ○ **Option Menu** key.

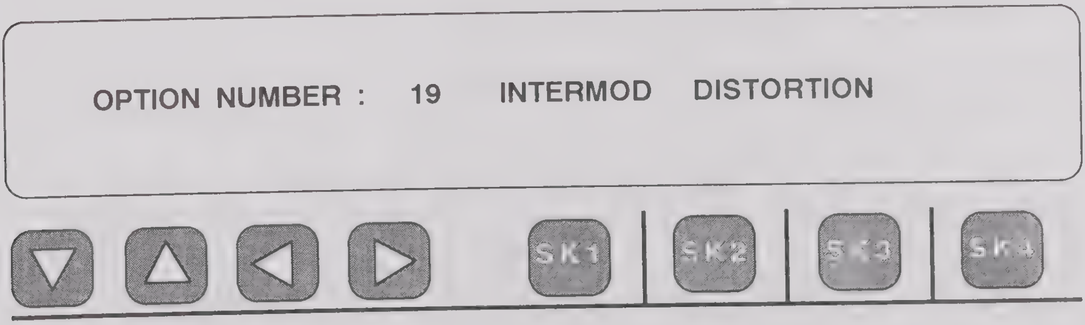
Use the UP/DOWN ▽ △ arrow keys

to select Menu Option 19: INTERMOD DISTORTION.

---

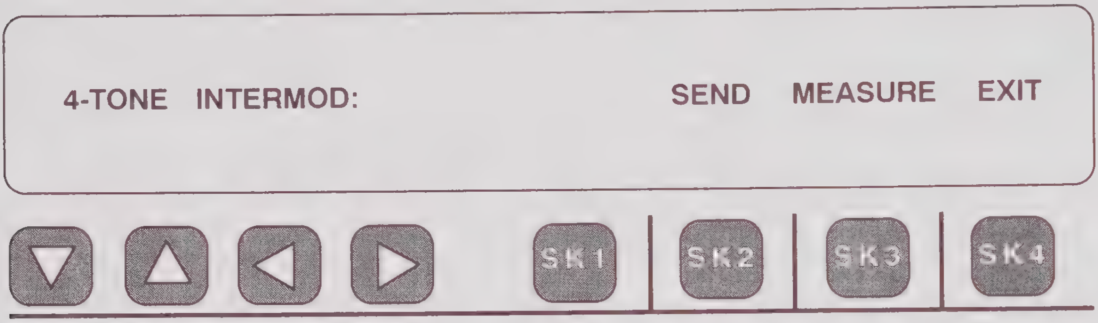
* Licensed under HLI Patent No. 3,862,380

The Model 930A display will appear as shown below:

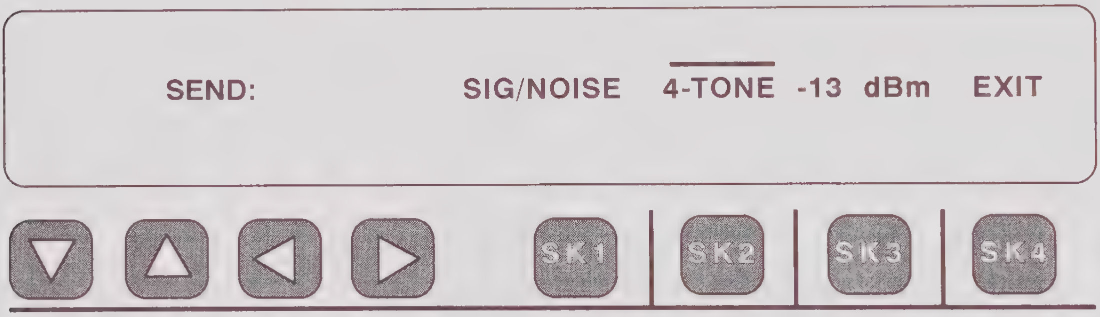


OPTION NUMBER : 19 INTERMOD DISTORTION

Press any softkey under the display to enter the Menu Option:

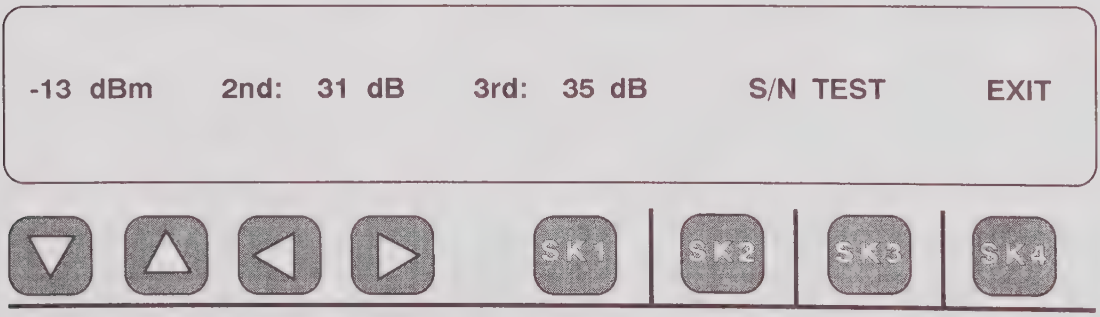


Press Softkey 2 (under **SEND**) to adjust the level at which the **IMD** tones are sent, to select the signal-to-noise test tones, or to send the Intermod tones over a two-wire circuit. Press Softkey 2 to bring up the display:



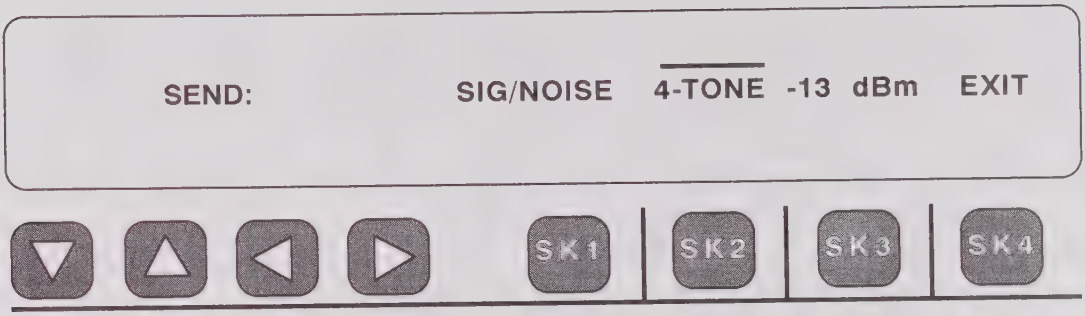
The cursor appears over the last test selected. To send the signal-to-noise test tones, press Softkey 1 (under **SIG/NOISE**). This will suppress one tone pair while amplifying the other pair to maintain the same average level. This measurement is usually performed before **IMD** testing since the test set uses the **S/N** value to automatically correct the **IMD** measurement results.

A Signal-to-Noise measurement display example is shown below:



The **S/N** values for the low and high tone pairs occupy the 2nd and 3rd order distortion positions.

Returning to the main **SEND** display:



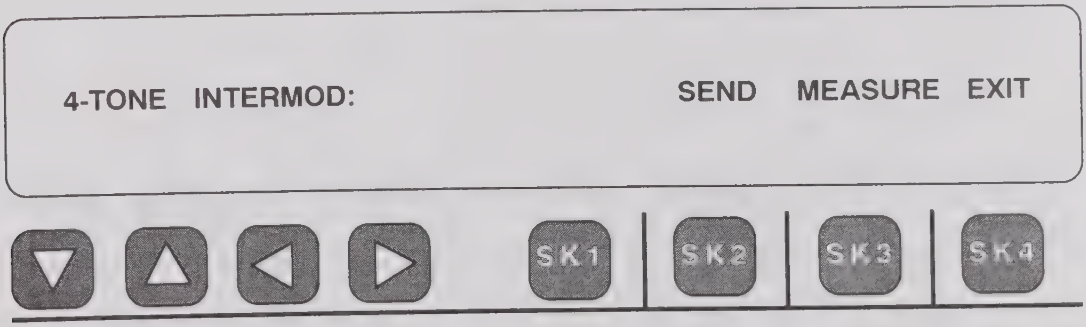
Press Softkey 2 (under **4-TONE**) to send the four intermodulation distortion test tones at the level displayed. On a two-wire circuit, another 930A, or a test set with Intermod Distortion measuring capability, must be at the distant end.

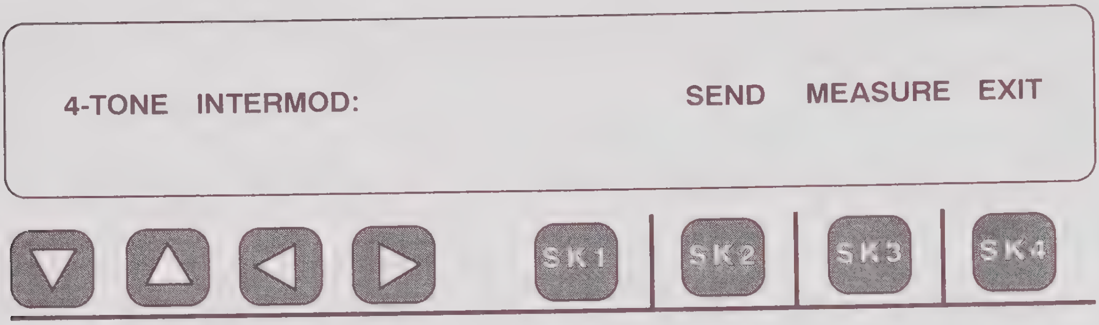
If a transmit level other than the default value of -13 dBm is desired, simply enter the new value using the numeric keypad. Press the **ENT**(Enter) key after the new level has been keyed in. The range of permissible values for the send levels vary with Trunk Type selected. These values are:

Analog:	-40 dBm to +0 dBm
PCM:	-40 dBm to -6 dBm

The Model 930A will prevent entry of levels outside those specified above.

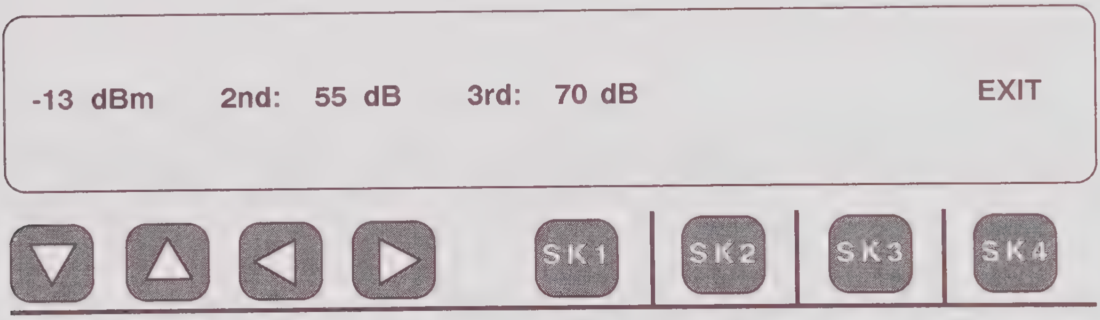
Press Softkey 4 to **EXIT** to the main **IMD** menu. This will not interrupt the tones being sent. From the main menu, the test can be terminated, or the **MEASURE** mode can be selected to test on a 4-wire looped-back circuit.





Pressing Softkey 4 (under **EXIT**) will terminate testing. Pressing Softkey 3 (under **MEASURE**) measures the Intermodulation Distortion present on the trunk under test. This will not disable the tones being sent under the **SEND** sub-menu unless a 2-wire trunk type has been selected.

Pressing Softkey 3 (under **MEASURE**) will bring up the **IMD** measurement display. A typical display is shown below:

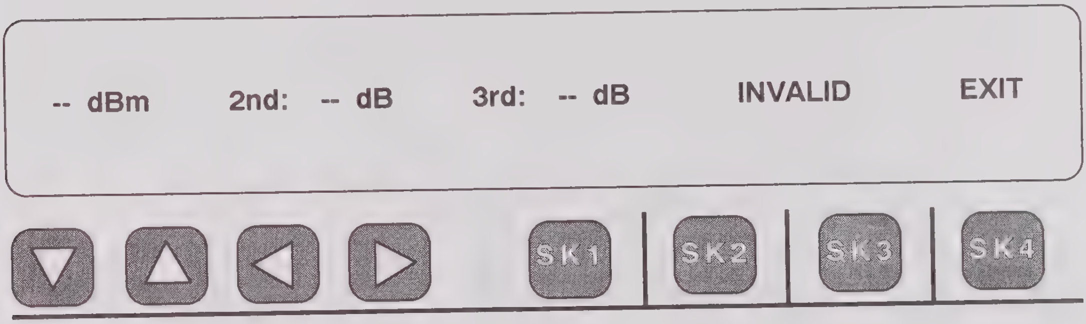


The first field in the above display (labeled **-13 dBm**) shows the composite received level of the four **IMD** tones in this example. If no signal is present this field will be blank. The second field (labeled **"2nd: dB"**) is the level at which the second-order IM products are being received below the level of the four **IMD** tones. In this example, the second-order products are 55 dB below the **IMD** tone level of -13 dBm for a total of -68 dBm. Similarly, the third field (labeled **"3rd: dB"**) is the level at which the third-order IM products are being received below the -13 dBm signal level.

The gap between the third field and the word **"EXIT"** is reserved for messages.

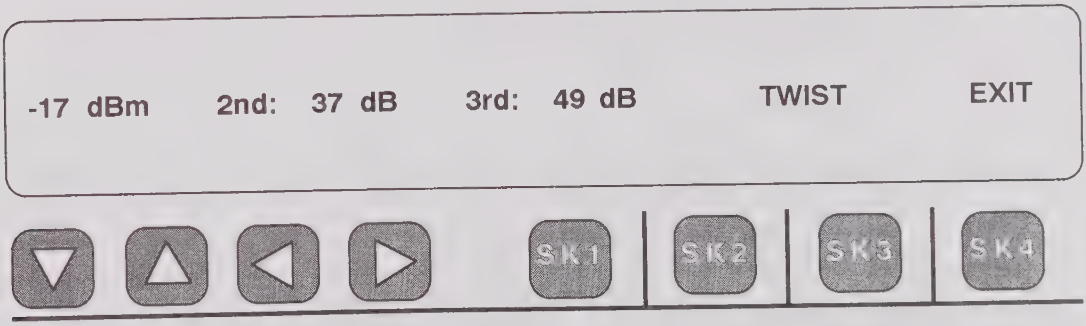
These messages are:

1. The message **"INVALID"** indicates an invalid signal; i.e., the **IMD** signal is absent, the level is below -40 dBm, or too high for the circuit (>0 dBm in analog, >-6 dBm in PCM). A typical display is shown below:



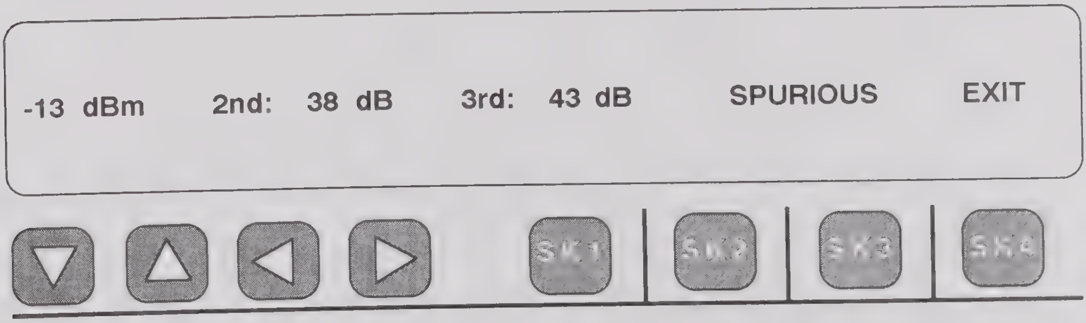
```
-- dBm     2nd:  -- dB     3rd:  -- dB     INVALID     EXIT
```

2. The message **"TWIST"** indicates that the **IMD** tones are being received at unequal levels (i.e., they differ by more than 6 dB from each other). A sample display is:



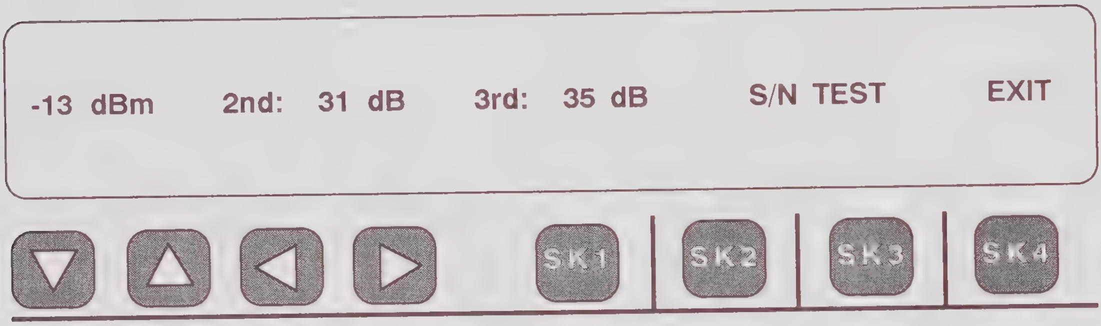
```
-17 dBm     2nd:  37 dB     3rd:  49 dB     TWIST     EXIT
```

3. The message **"SPURIOUS"** indicates the presence of a spurious tone (any tone other than the four test tones). A typical display follows:



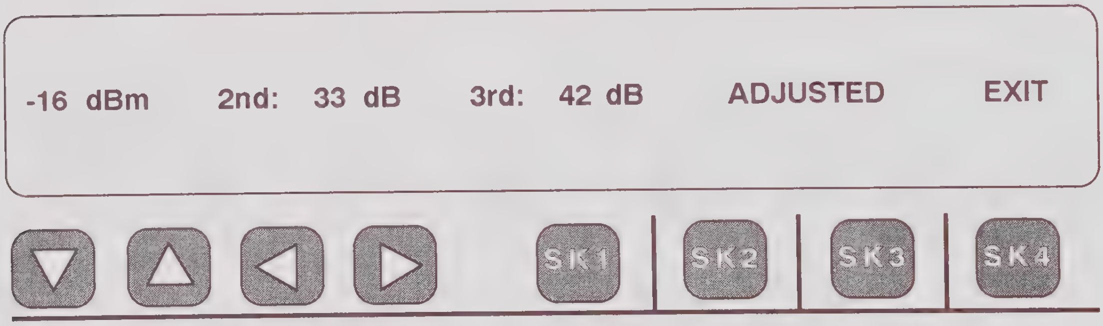
```
-13 dBm     2nd:  38 dB     3rd:  43 dB     SPURIOUS     EXIT
```

4. The message **"S/N TEST"** shows that the 930A is receiving the signal-to-noise test tones. The fields labeled **"2nd: dB"** and **"3rd: dB"** now contain noise measurements where the distortion products used to be. The measurements are in dB below the received signal as a **S/N** ratio. The display will appear as:



-13 dBm 2nd: 31 dB 3rd: 35 dB S/N TEST EXIT

5. The message **"ADJUSTED"** indicates that the distortion measurements are being corrected automatically for signal-to-noise ratio. A typical display is:

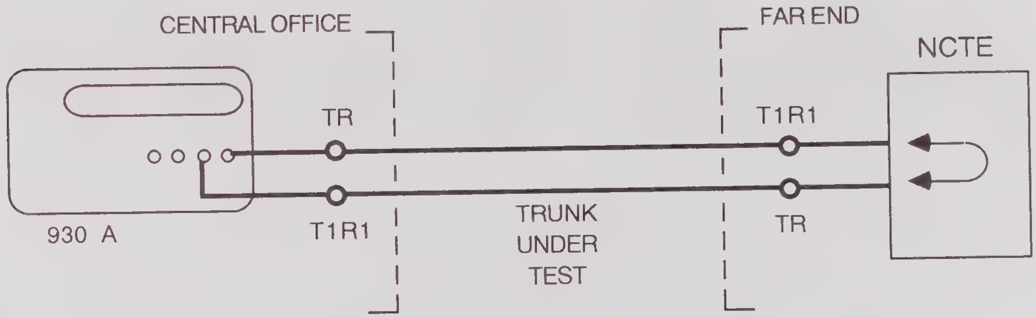


-16 dBm 2nd: 33 dB 3rd: 42 dB ADJUSTED EXIT

The following example of a corrected **IMD** test performed on a 4-wire circuit will serve to clarify the procedure.

4-10.1 MAKING A 4-TONE IMD TEST ON A FOUR-WIRE CIRCUIT

The trunk to be tested is a 4-wire circuit. It is also assumed that there is Network Channel Terminating Equipment (NCTE) at the far end which is capable of providing a loopback on the line. A typical circuit diagram is shown below:



To make a corrected measurement of Intermodulation Distortion:

1. Select the correct Trunk Type on the 930A as described in Section 3-4, and connect the test cords as shown in Section 3-4.4.

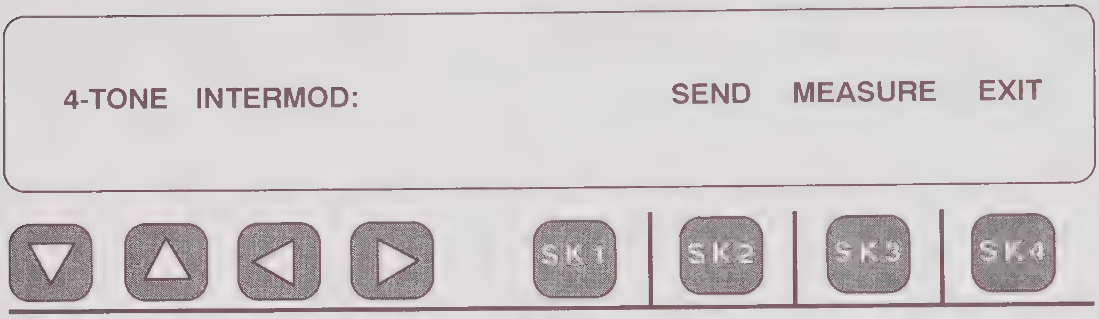
2. If the trunk under test is a dedicated line, and not a dial-up line, proceed to step 3. If not, press the **DIAL/RING** key, go **Off Hook**, and dial the far end loopback device's number. Refer to Section 3-5 for dialing instructions.

3. Press the **SEND TONE** key and set the 930A to send 2713 Hz at -10 dBm for 5 seconds to loop the device at the far end. Refer to Section 3-7 for Send Tone instructions.

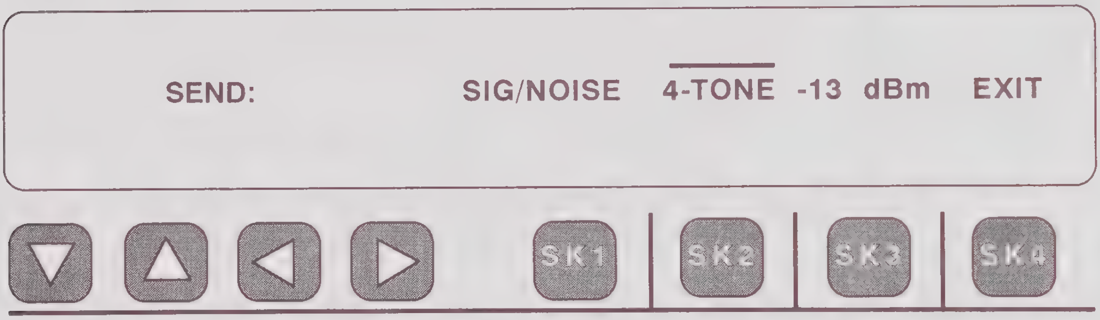
4. Press the **MEASURE TONE** key. When the line is looped, the 2713 Hz tone will be displayed and the tone will be audible.

5. Press the **SEND TONE** key again and press Softkey 4 to turn off the 2713 Hz tone.

6. Press the **OPTION MENU** key. Enter the numbers **1** and **9**. Press the **ENT** (Enter) key. The 930A display will become:

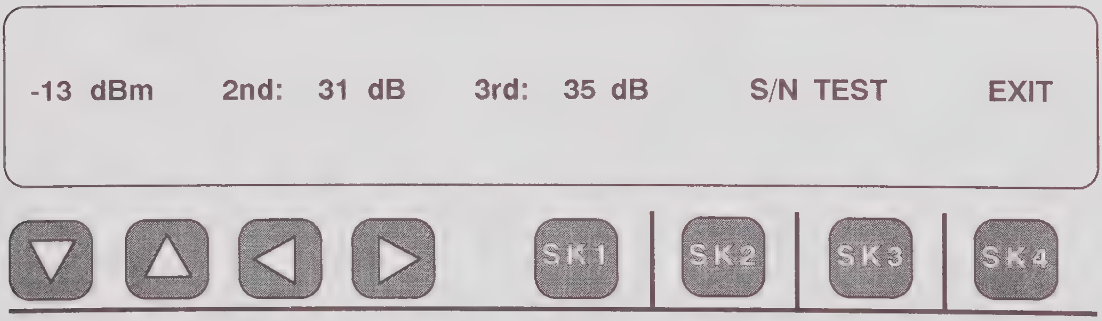


7. Press Softkey 2 (under **SEND**). The 930A display will change to:

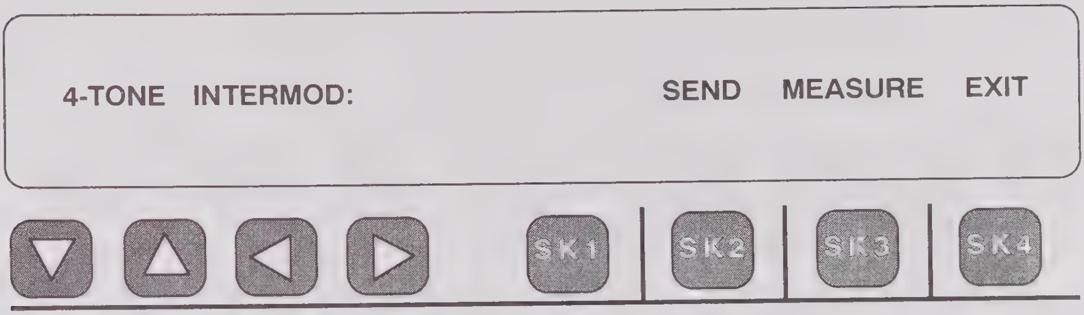


8. Press Softkey 1 (under **SIG/NOISE**), and set the level to -13 dBm if it is not at that level. Press Softkey 4 to **EXIT** to the main menu. The 930A sends the Signal-to-Noise test tones.

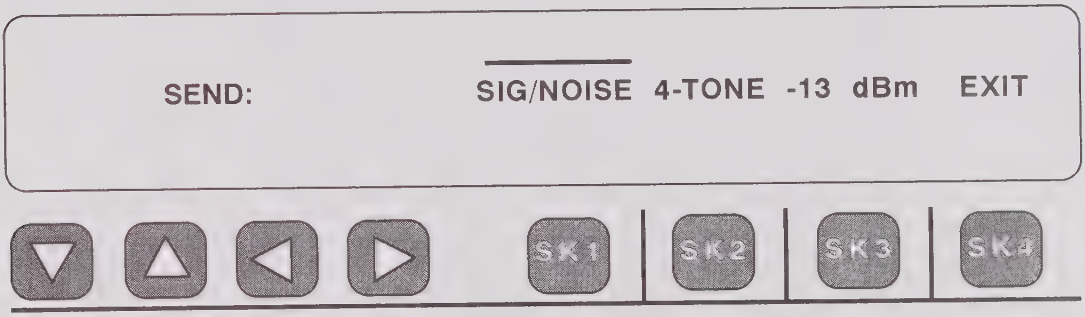
9. Press Softkey 3 to select **MEASURE**. Wait for a few seconds for the measurements to stabilize. The received level and the fields labeled **"2nd: dB"** and **"3rd: dB"** will contain test results. A typical display will be:



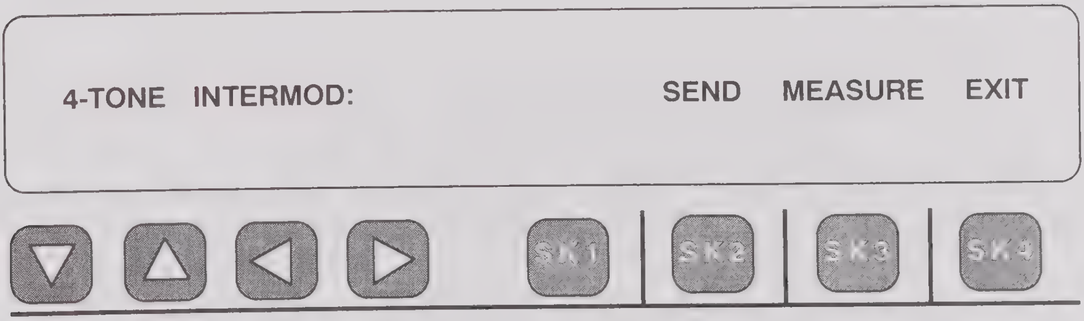
10. Press Softkey 4 to exit back to the main menu.



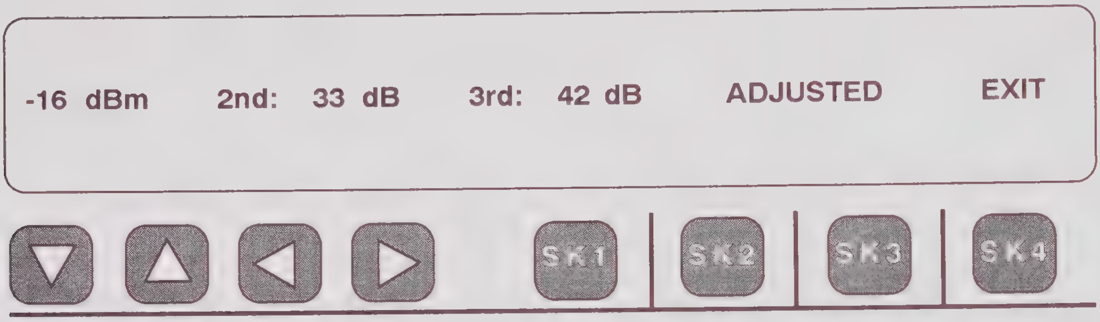
11. Press Softkey 2 to select **SEND**.



12. Press Softkey 2 (under **4-TONE**) and the 930A sends the **IMD** test tones at -13 dBm. Press Softkey 4 to exit back to the main menu.



13. Press Softkey 3 (under **MEASURE**). Wait for a few seconds for the measurement to stabilize. The word "**ADJUSTED**" should appear to the left of the word "**EXIT**". An example of a corrected Intermodulation Distortion products display is shown on the following page.



14. Before going back On-Hook, press the **SEND TONE** key and send the 2713 Hz tone again to release the loopback. When this has been accomplished, place the 930A On-Hook, or **EXIT** from the Menu Option, to terminate testing.

4-11 BATCH MODE TESTING WITH THE 930A (OPTION 930A-29)

Batch Mode allows the user to program the 930A to place multiple calls automatically, beginning at a scheduled time, and to store the results of these calls in memory. The “results” may be call disposition (busy, reorder, etc.), wink timing, or measurements made to a remote test line such as a 105 responder.

Expanded memory (64K RAM Option 930A-32) is not required for Batch Mode, but is strongly recommended. Batch operations can very quickly use up the 39 memory locations that are standard with the 930A. The 64K RAM expansion gives the user 899 memory locations to work with. You must also have Option 930A-10C installed since Batch Mode uses the real-time clock.

You may set up Batch Mode manually, but it is generally more useful under remote control. Using Batch Mode, a single computer can program several 930As to perform automated tests over a network simultaneously. This allows the user to build a powerful but inexpensive automated trunk routining system for private networks. Manual use of Batch Mode is helpful for repetitive tasks such as placing fifty calls to the same test line or placing calls at odd hours when the user would prefer to be asleep.

4-11.1 HOW BATCH MODE WORKS

First, you enter the telephone numbers (using the **DIAL/RING** function) that will be called in Batch Mode and store them into the 930As memory locations as outlined in section 3-5.2, page 3-43.

Once you have entered the telephone numbers, you select **Menu Option 50: BATCH MODE**. This is where you will enter the call sequence. The call sequence tells the 930A how many calls to place, where the telephone numbers are stored and where to store the test results. It also tells the 930A when to pause for dial tone, winks, or other supervision and whether a test line will answer the call.

Once the call sequence is set, you tell the 930A when to begin testing and then press the softkey under **TEST**. When the scheduled time arrives, the 930A will execute the tests and store the results.

A WORD OF WARNING

Programming the 930A for Batch testing is a complicated task. A thorough understanding of the process is a necessary prerequisite to success.

You will have to perform the following steps:

Set up the 930A to operate on the correct trunk type.

Enter the telephone numbers to be called using the DIAL/RING function and store the into memory using the STO key.

Select Menu Option 50: BATCH MODE.

Enter Menu Option 50 (press any softkey under the display).

Press Softkey 1 under **SET-UP**.

Press Softkey 1 again to enter the call sequence.

Exit from the call sequence menu when finished and press Softkey 3 under **TIMING** to enter the time duration between calls in batch mode.

Exit back to the main menu and press Softkey 2 under **TEST**.

Press Softkey 3 under **INFO** in the main display if you want to determine your set ups without re-entering them.

4-11.2 BATCH MODE CAPABILITIES AND EXAMPLES

You may place up to 899 calls (with 64K RAM Option 930A-32) in a single batch test. The number of different telephone numbers you may call and the maximum number of test results you may store will depend upon the amount of memory installed in the 930A.

You may specify the testing to begin at any time of day, any day, month or year. If the time and date specified are earlier than the current time, testing will begin immediately.

At any point in the call sequence, or at multiple points, you may pause for one second, pause for dial-tone, pause for a wink, pause for an off-hook from the far end or a delay-dial event.

You may specify that a single telephone number be outpulsed for every call made in batch mode. You will be prompted to tell the 930A where that telephone number has been stored in memory. This is called a fixed # or an unchanging telephone #. A single call sequence may include up to four fixed numbers. If you wished to place fifty calls to the same test line, for example, you would store the telephone number of the test line in 930A memory, program batch mode for fifty calls to a fixed #, and give the memory location in which you had stored the test line's telephone number.

You may have the 930A outpulse a different telephone number for every call made in batch mode, provided that these numbers have been stored into sequential memory locations in the 930A. This is called a **BATCH** of telephone numbers. You will be prompted to tell the 930A the memory location of the first number. The 930A will dial the number stored in that memory location when it places the first call in batch mode. On the second call, it will dial the number stored in the next register location. It will continue to increment the memory location for every call it places in batch mode. Suppose, for example, that you wished to test ten different circuits, each of which could be accessed by dialing a specific sequence of digits into your test port. You would store the access digits for the first circuit into a 930A memory location, such as location 1. You would then store the digits for the second circuit in register 2 and so on. This is done by pressing the **DIAL/RING** function key, entering the access digits, pressing the **STO** key and entering the number of the memory location. You would then press the **OPTION MENU** function key, go to Menu 50, enter Batch Mode and program the

930A to place ten calls, select a **BATCH** of telephone numbers, and give the location of the first access digits (location 1 in this example). You may program the 930A to use up to four batches of telephone numbers in a single test sequence.

You can mix batches of changing and unchanging (fixed) telephone numbers in a single call sequence. Suppose, for example, that you wanted to access ten different telephone circuits, each of which had a different access number, and then test each circuit to the same far end test line. You would set up and store the access numbers as in the previous example, then store the far end test line number in, say, location 11. You would then go to batch mode, tell the 930A to place ten calls, program it to begin with a **BATCH** of telephone numbers beginning at location 1, then dial a **FIXED #** stored in location 11. On the first call, the 930A would dial the number stored in location 1 (accessing the first circuit), then dial the number stored in location 11 (dialing the test line). On the second call, the 930A would dial the number stored in location 2 before dialing the test line number (still in location 11), and so on.

You may program the 930A to expect a test line to answer the call. You may further program the 930A to expect a 100, 102, 105 or 125 test line. A type 100 test line provides quiet termination for noise measurements. A 102 test line provides milliwatt tone. It may be continuous or intermittent. A 105 test line is a CAROT compatible responder which includes the SAGE Model 356E Voice/Data responder or a 930A acting as a far end responder. A 125 test line is an HLI type 115 or 125 transponder (not CAROT compatible). When setting up the call sequence in batch mode, select TESTLINE, then select 102, 105 or 125 as appropriate.

The tests which will be performed will depend upon the type of test line selected. When testing to a type 100 test line you may measure C-Message noise or 3 KHz noise. When testing to a type 102 test line you can measure one-way loss, C-Notch noise, and signal-to-noise ratio. These tests are selected in **Menu Option 29: CALL 102 LINE**. When testing to a standard 105 test line, you can choose to test two-way loss, gain/slope, C-Message and C-Notch noise, and/or return loss (ERL, SRL and/or SRH). If the responder is a SAGE Model 356E, you may additionally test two-way attenuation distortion, signal-to-noise ratio, 3 KHz Flat noise, P/AR, Intermodulation distortion, phase and amplitude jitter (20 to 300 Hz and/or 4 to 300 Hz bands), envelope delay distortion, and/or impulse noise and hits. These tests are selected in **Menu Option 26: ROTL/RESPONDER**. When testing to a 125 or a 115 test line, you may select two-way loss, gain/slope and/or C-Message and C-Notch noise tests. These tests are selected in **Menu Option 28: TRANSPONDER TEST**.

You may instruct the 930A to remain on-hook for a specific duration between calls made in batch mode. You may select an on-hook interval of 10 to 9999 milliseconds in 10 millisecond increments.

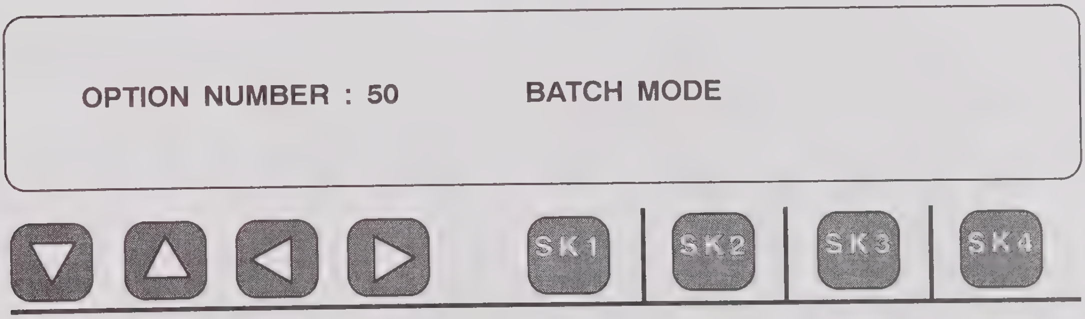
4-11.3 KEY FUNCTIONS IN BATCH MODE

In this section, the operation of the front panel keys in batch mode will be outlined. To begin,

Press the OPTION MENU ■ ○ **Option Menu** function key.

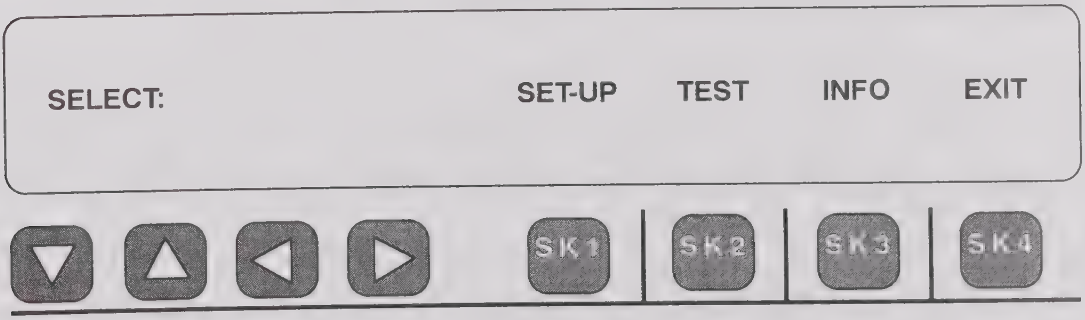
Use the UP/DOWN ▽ △ arrow keys to

select Menu Option 50: BATCH MODE.

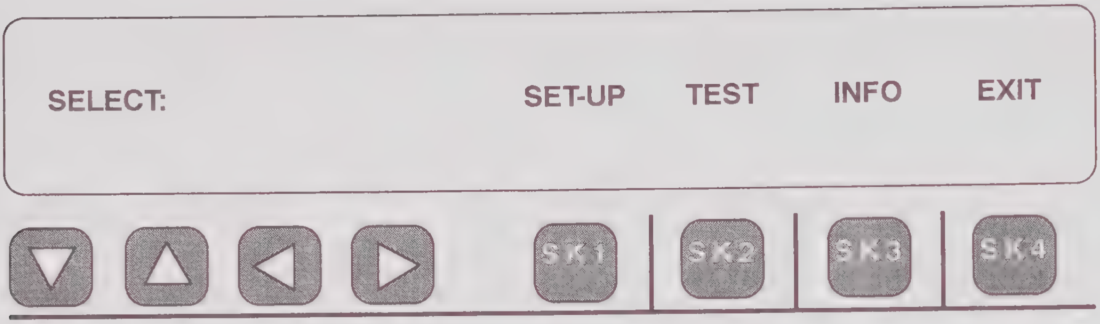


OPTION NUMBER : 50 BATCH MODE

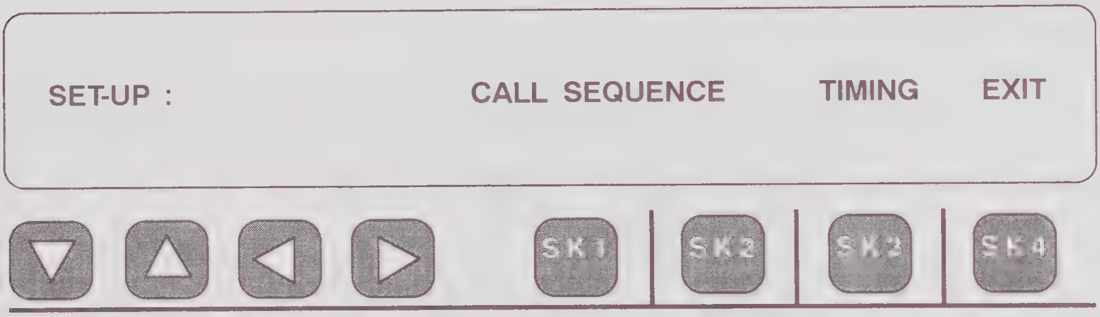
Press any softkey under the display to bring up the main select menu.



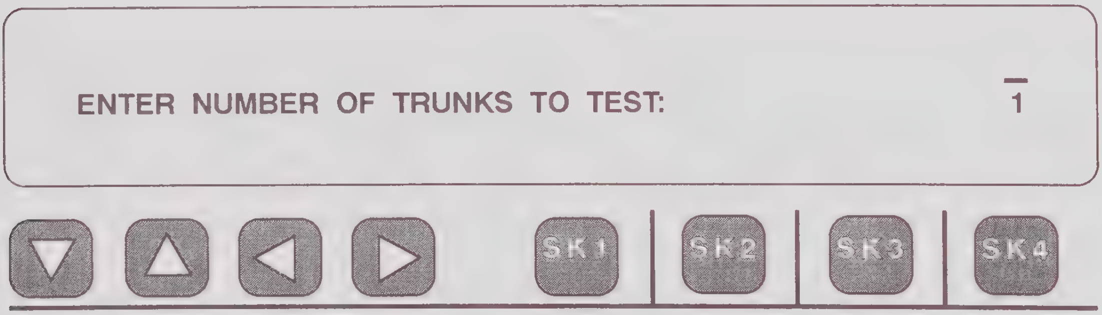
SELECT: SET-UP TEST INFO EXIT



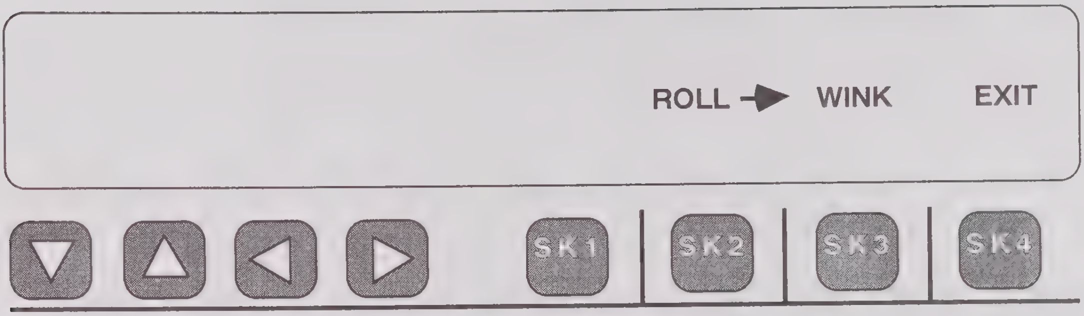
To set up BATCH MODE, press Softkey 1 under **SET-UP**. The following display will appear:



To set up the call sequence, press Softkey 1 or 2 under **CALL SEQUENCE** and you will be prompted as follows:



Enter the number of calls you want the 930A to place in batch mode using the numeric keypad and then press the Enter (**ENT**) key. You can enter from 1 to 899 trunks. The display will advance to the next set-up screen after you enter the number.



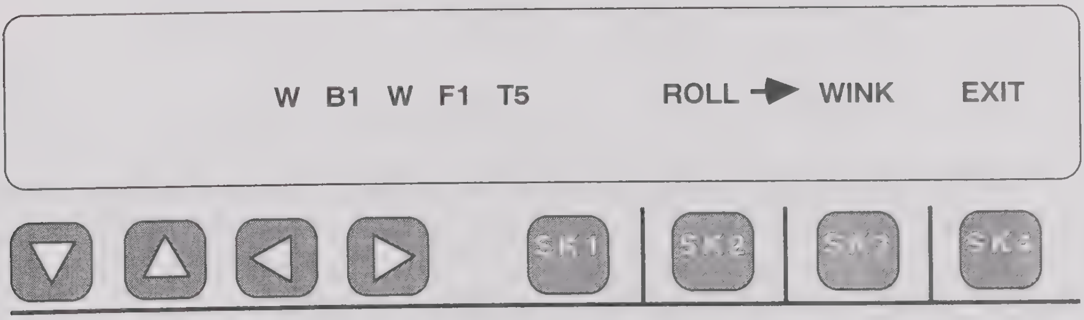
If there are any characters showing to the left of the word ROLL, they represent a call sequence that was entered previously. Press the Clear (**CLR**) key to obtain the display above. If you make a mistake entering the call sequence at any time, press **CLR** and start over.

Softkey 2 is labeled "**ROLL ->** ". It is a wheel which allows you to select the next item in the call sequence. It begins with **WINK**. By pressing Softkey 2, under "**ROLL ->** ", you can select **OFF-HK, DELAY, PAUSE, FIXED #, BATCH, TESTLINE** or **DIALTONE**.

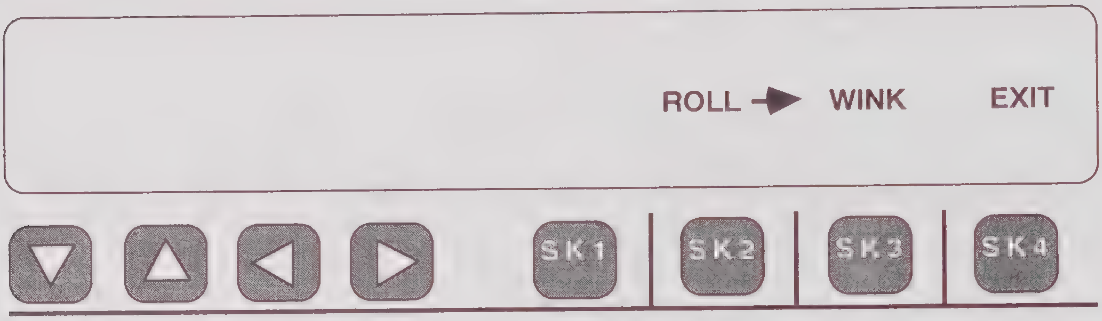
The **UP/DOWN** arrow keys can also be used to scroll through the choices on the wheel.

Whenever Softkey 2 or the arrow keys are pressed, the display over Softkey 3 changes. Again, it may show **WINK, OFF-HK, DELAY, PAUSE, FIXED #, BATCH, TESTLINE** or **DIALTONE**.

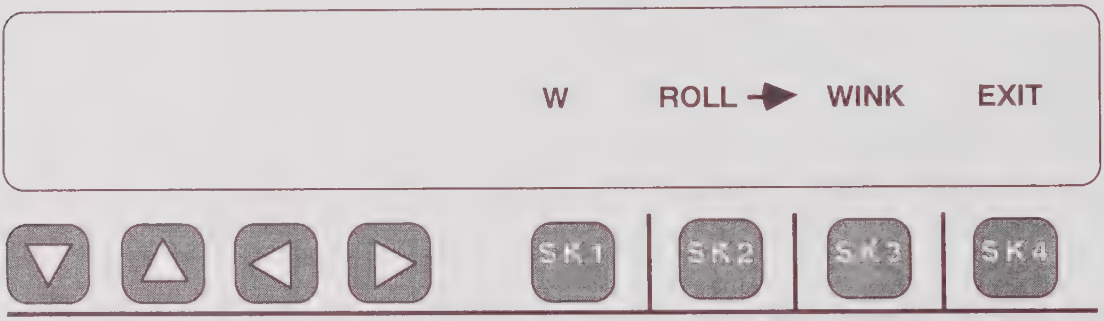
Pressing Softkey 3 will enter whatever is shown above the softkey into the call sequence. A letter or a letter and number representing he event will be added to the sequence and displayed on the left half of the screen. After any selection is entered, the word "WINK" will reappear over Softkey 3. A full sequence might look like:



4-11.3.1 POSSIBLE EVENTS IN THE CALL SEQUENCE



Pressing Softkey 3 when the word "**WINK**" is displayed above it causes the letter "**W**" to appear in the sequence.



When testing in the batch mode, a "**W**" causes the 930A to wait for a wink from the far end before proceeding. The length of the wink and the time spent waiting for it will be recorded in **Menu Option 9: WINK TIMING**. If no test line is specified at the end of the call sequence, the wink timing information will also be recorded in **Menu Option 51: TEST RESULTS**.

Pressing Softkey 3 when the word "**OFF-HK**" is displayed above it causes the letter "**H**" to appear in the sequence.

ROLL -> OFF-HK EXIT

H ROLL -> WINK EXIT

After the "**H**" has been entered the display reverts back to showing WINK over Softkey 3. When testing in batch mode, an "**H**" causes the 930A to wait for the far end to go off-hook before proceeding. The length of time spent waiting for the off hook and the length of the off hook (up to 200 milliseconds) will be recorded in **Menu Option 9: WINK TIMING**. If no test line is specified at the end of the call sequence then this information will also be recorded in **Menu Option 51: TEST RESULTS**.

Pressing Softkey 3 when the word "**DELAY**" is displayed above it causes the letter "**D**" to appear in the sequence.

ROLL -> DELAY EXIT

D ROLL -> WINK EXIT

When testing in batch mode, a "**D**" causes the 930A to wait for the far end to provide a delay dial event before proceeding. The length of time spent waiting for the event and the length of the event will be recorded in **Menu Option 9: WINK TIMING**. If no test line is specified at the end of the call sequence then this information will also be recorded in **Menu Option 51: TEST RESULTS**.

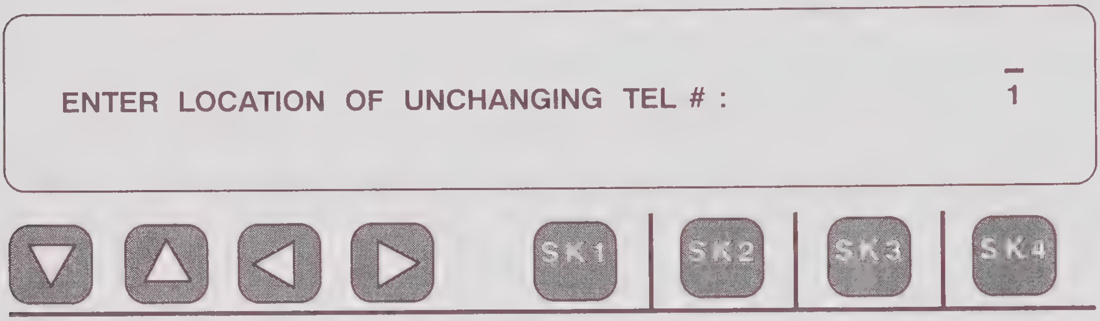
Pressing Softkey 3 when the word "**PAUSE**" is displayed above it causes the character "**-** " to appear in the sequence.

ROLL -> PAUSE EXIT

- ROLL -> WINK EXIT

When testing in batch mode, a "**-** " causes the 930A to wait for one second before proceeding.

Pressing Softkey 3 when the word "**FIXED #**" is displayed above it causes the 930A to prompt the user:



ENTER LOCATION OF UNCHANGING TEL # : 1

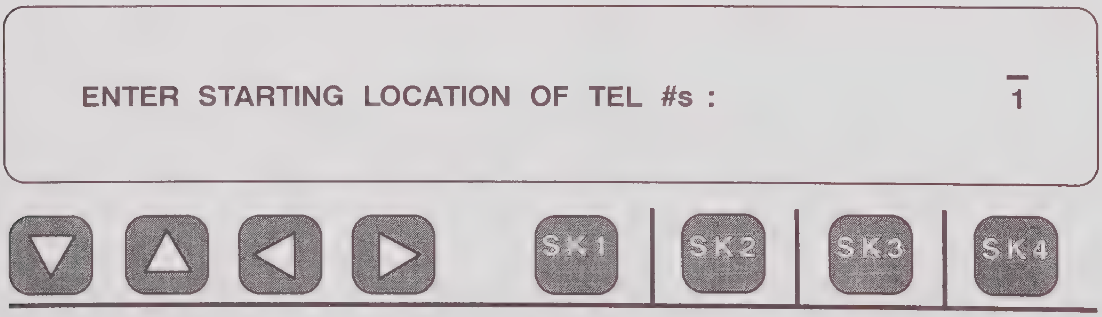
Use the numeric keypad to enter the number of the memory location where the telephone number is stored and then press the **ENT** key. The letter "**F**", followed by a "**1**", "**2**", "**3**" or "**4**" will be inserted into the call sequence. The 930A can have up to four fixed numbers in a call sequence.

ROLL -> FIXED # EXIT

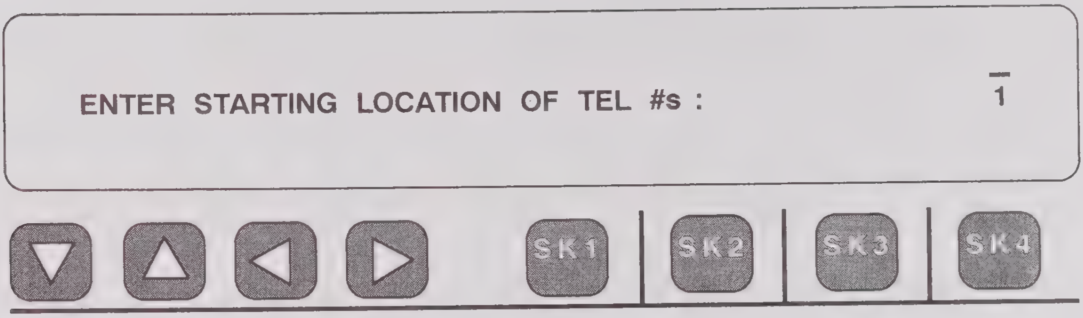
F1 ROLL -> WINK EXIT

When testing in batch mode, a "**F**" causes the 930A to recall a telephone number stored in memory and dial it. The same number will be recalled and dialed each time. You may use up to four fixed numbers in a sequence. Use the **DIAL/RING** function to enter the telephone number into the 930A and then press the **STO** key to store it into a memory location. This should be done **BEFORE** setting up the sequence in **BATCH MODE**.

Pressing Softkey 3 when the word "**BATCH**" is displayed above it causes the 930A to prompt the user:



ENTER STARTING LOCATION OF TEL #s : 1



ENTER STARTING LOCATION OF TEL #s : 1

Use the numeric keypad to enter the number of the memory location where the first telephone number is stored and then press the **ENT** key. The letter "**B**", followed by a "**1**", "**2**", "**3**" or "**4**" will be inserted into the call sequence.

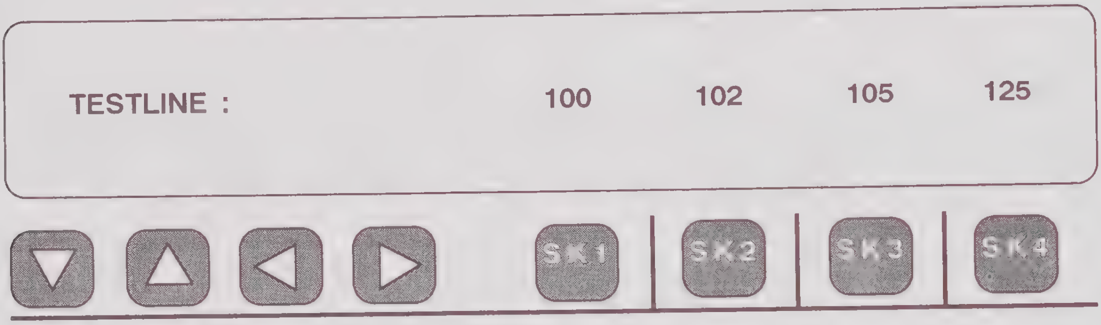
ROLL -> BATCH EXIT

B1 ROLL -> WINK EXIT

When testing in batch mode, a "**B**" causes the 930A to recall a telephone number stored in memory and dial it. The memory location will be incremented each time the 930A places a call. You must have telephone numbers stored in sequential memory locations beginning at the **STARTING LOCATION** you were prompted for. You must have as many numbers stored as you programmed **BATCH MODE** to test (i.e., if you input "**4**" as the "**NUMBER OF TRUNKS TO TEST**", and "**1**" as the "**STARTING LOCATION OF TEL #s**", you must have numbers stored into locations 1, 2, 3 and 4). You may use up to four batches in a sequence. Use the **DIAL/RING** function to enter the telephone numbers into the 930A and then press the **STO** key to store them into sequential memory locations. This should be done **BEFORE** setting up the sequence in **BATCH MODE**.

If you have not purchased Option 930A-32 64K RAM Expansion, you will have only 39 memory locations in the test set. This is the maximum number of sequential telephone numbers you can store. Option 930A-32 expands this number to 1000.

Pressing Softkey 3 when the word "**TESTLINE**" is displayed above it causes the 930A to prompt the user:



Use the softkeys to select a type 100, 102, 105 or 125 test line. A **"T0", "T2", "T5" or "T1"** will be inserted into the call sequence. For example if you press Softkey 3 under **105**, the display will change from:

ROLL -> TESTLINE EXIT

to

T5 ROLL -> WINK EXIT

When testing in batch mode, a "**T**" causes the 930A to expect a test line to answer the telephone. If the "**T**" is followed by a "**0**", the 930A expects a type 100 test line (Quiet Termination). If the "**T**" is followed by a "**2**", the 930A expects a type 102 test line (milliwatt). If the "**T**" is followed by a "**5**", the 930A expects a type 105 test line (52A responder, SAGE 356E responder or another 930A acting as a far end responder). If the "**T**" is followed by a "**1**", the 930A expects a type 115 or 125 HLI transponder.

The 930A will wait for the characteristic test progress tone sent by the specified test line. If it detects busy, reorder, dial-tone or some other continuous tone, it will record the network response time and call completion status and proceed with the next call. If the expected tone is not received within 60 seconds, the current status of the line will be recorded (dead line, ringing -- no answer or speech) and the 930A will proceed with the next call.

If the 930A receives the expected tone within 60 seconds, it will record the call completion time (from the end of the last event to receipt of the test tone) and perform any selected tests.

Tests to type 102 lines are selected in **Menu Option 29: CALL 102 LINE**. This is detailed in Section 4-11.4. Tests to type 105 test lines are selected in **Menu Option 26: ROTL/RESPONDER**. Details of using this menu option are contained in Section 4-6.2. Tests to type 115 or 125 transponders are selected in **Menu Option 28: TRANSPONDER TEST**. This menu option is explained in Section 4-12.1.

The same set of tests will be performed on each trunk tested in batch mode.

The test results (or call completion status and timing) will be stored in **Menu Option 51: TEST RESULTS**. This information supersedes any wink timing information that might otherwise have been stored in **TEST RESULTS**. More information on storing and retrieving test results is provided later in this section.

When the 930A encounters a "**T**" during batch testing, it goes on to the next call after the test line answers and tests have been performed or fails to answer. Anything in the sequence after a test line is ignored.

Pressing Softkey 3 when the word "**DIALTONE**" is displayed above it causes the letter "**-** " to appear in the sequence.

ROLL -> DIALTONE EXIT

d ROLL -> WINK EXIT

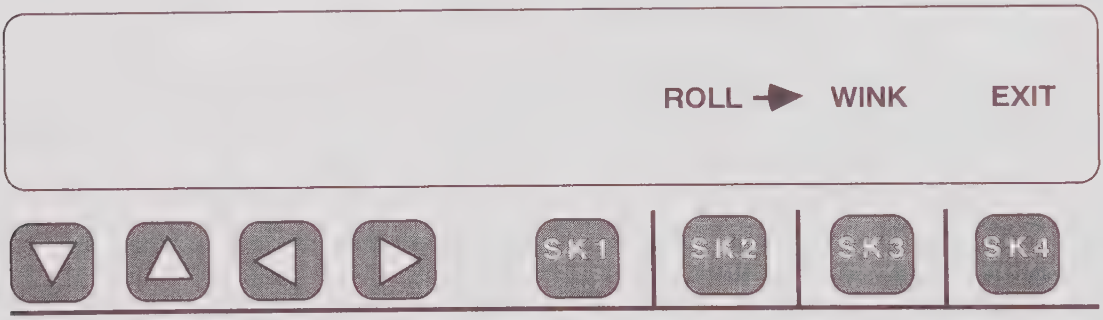
When testing in batch mode, a "**d**" causes the 930A to pause for dial tone before proceeding.

4-11.3.2 BATCH MODE EXAMPLE

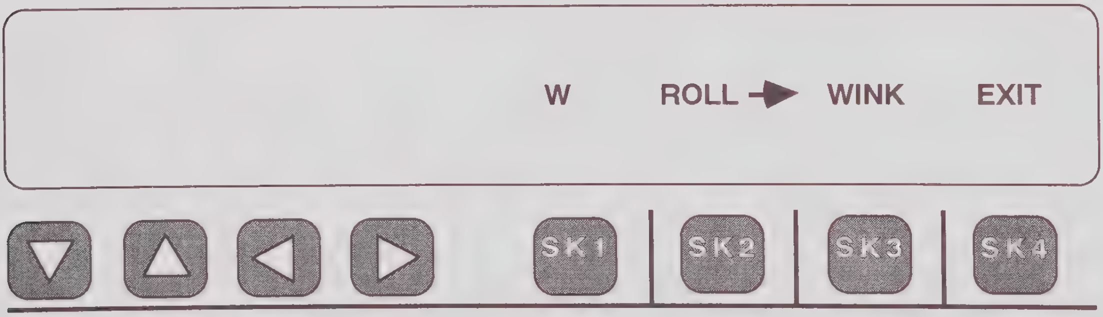
Suppose you wish to test five telephone circuits in batch mode. For each call, you want the 930A to go off hook, wait for a wink, dial the access code for one of the circuits, wait for another wink and then dial the number of a 105 test line.

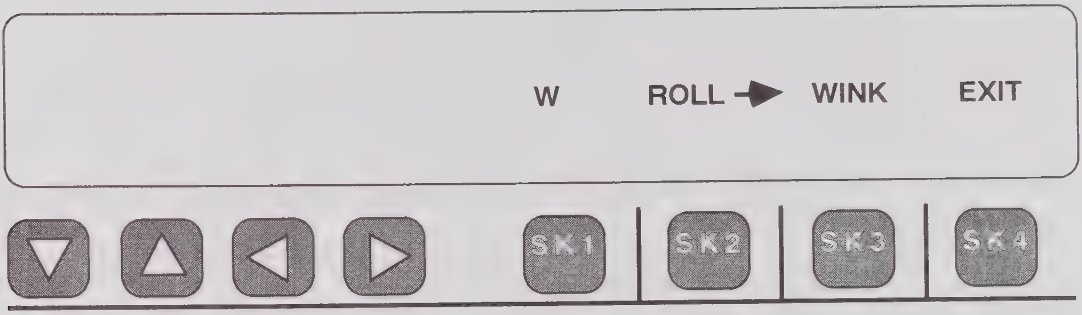
First, you would use the **DIAL/RING** function to enter the access codes for the five circuits, using the **STO** key to store the codes in five sequential memory locations (locations 1, 2, 3, 4 and 5, for example). Next, you would use the **DIAL/RING** function to enter the telephone number of the 105 responder. You would then store this number in memory location 6, in this example, using the **STO** key. Then you would enter **Menu Option 26: ROTL/RESPONDER** and select the tests that you want performed when the 105 responder is reached.

Once these steps are performed, you would go to **Menu Option 50: BATCH MODE**, press the softkey labeled "**SET-UP**", select "**CALL SEQUENCE**", answer "**5**" when prompted for the number of trunks to test, and enter the following sequence (you will see this display first):

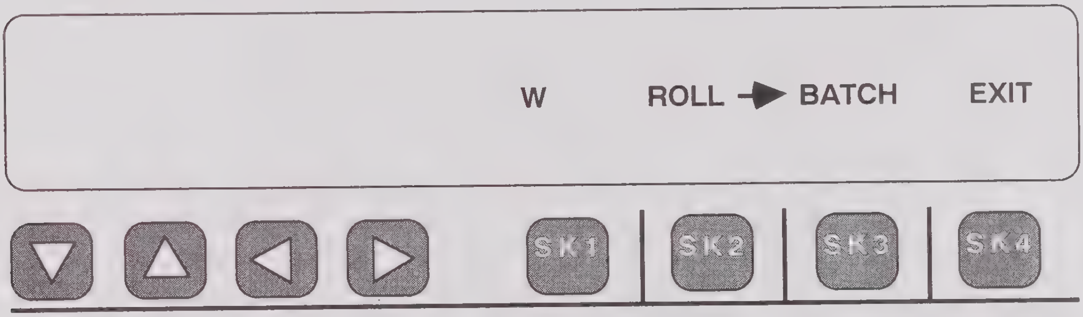


Press Softkey 3 and you will see this display:

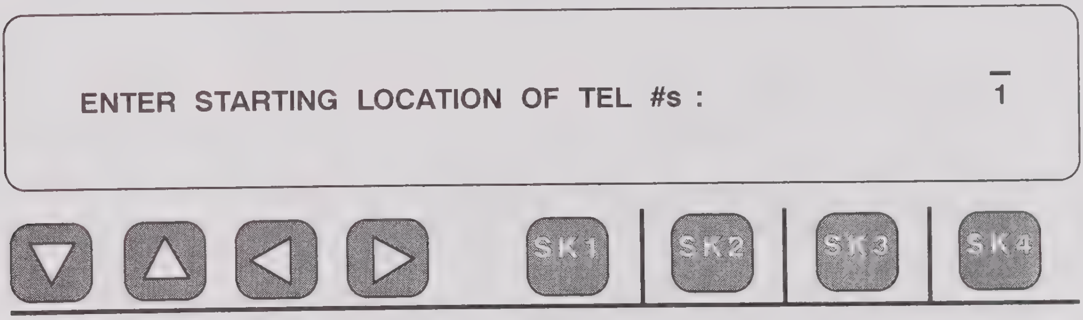




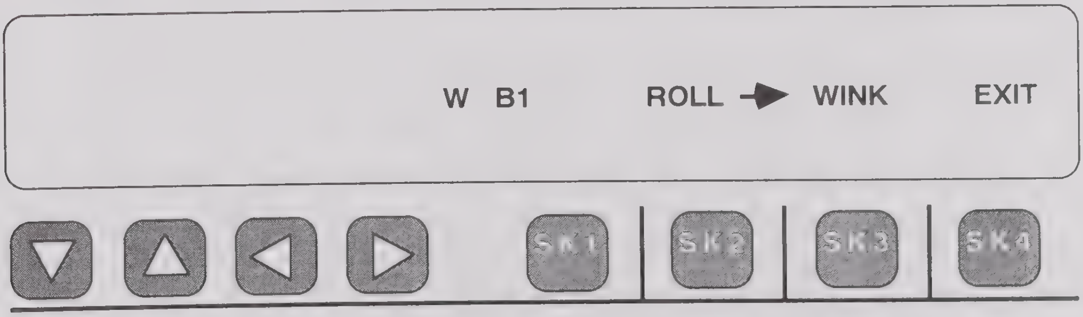
Press Softkey 2 until you see this display:



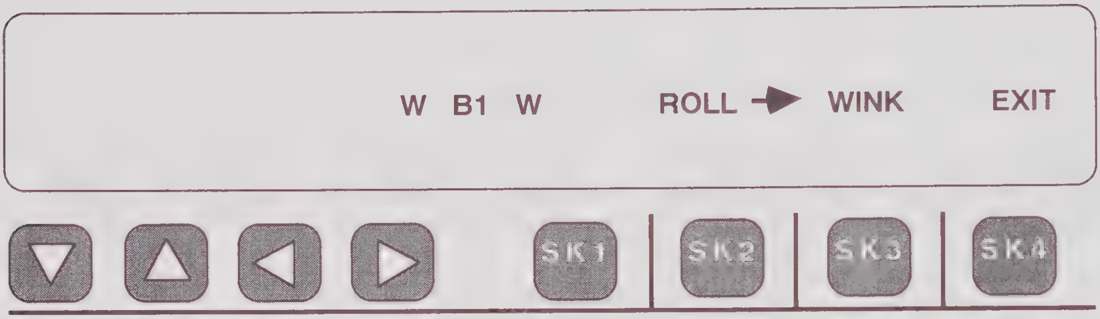
Press Softkey 3 under **BATCH** and you will see this display:


ENTER STARTING LOCATION OF TEL #s : $\bar{1}$

Press "**1**" and "**ENT**". You will see the display below:

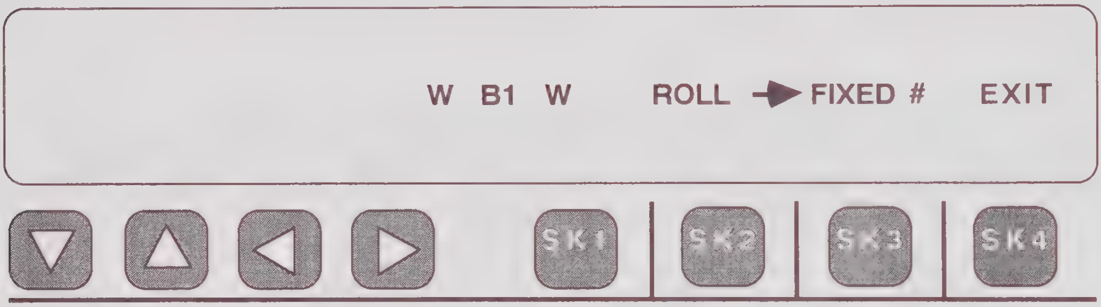


Press Softkey 3 and you will see this display:



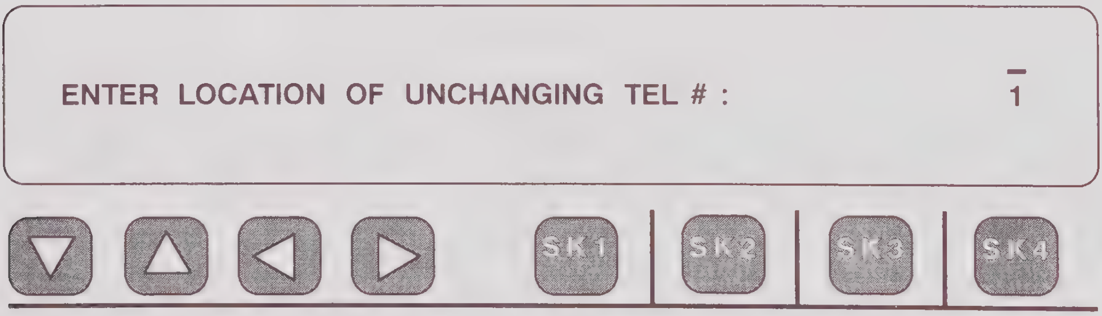
W B1 W ROLL → WINK EXIT

Press Softkey 2 until you see the display:



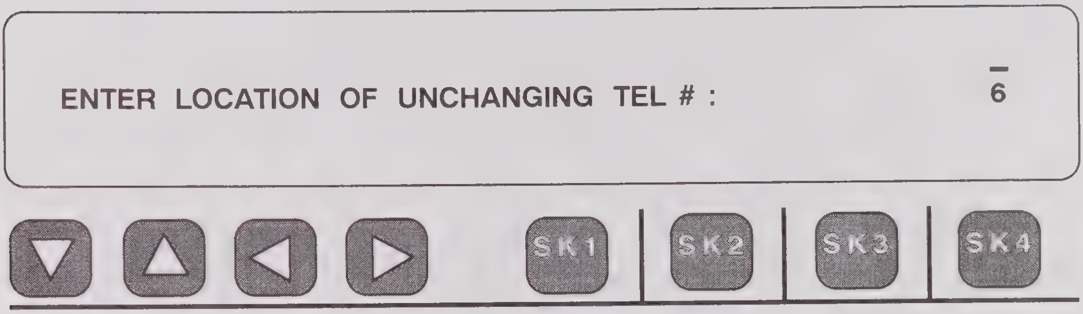
W B1 W ROLL → FIXED # EXIT

Press Softkey 3 and you will be prompted:

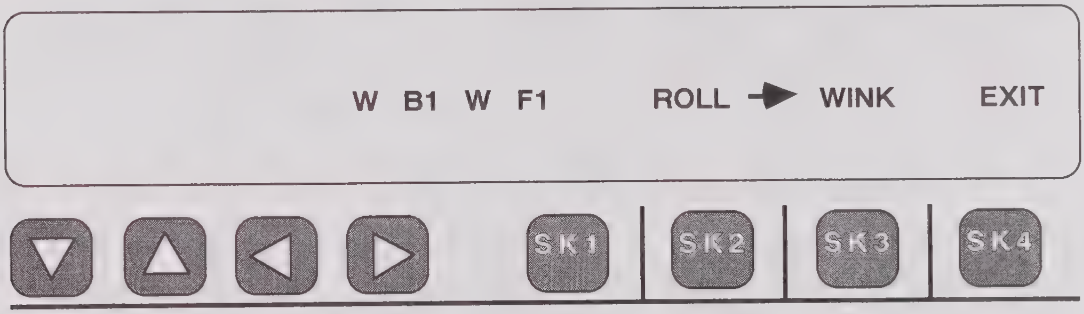


ENTER LOCATION OF UNCHANGING TEL # : 1

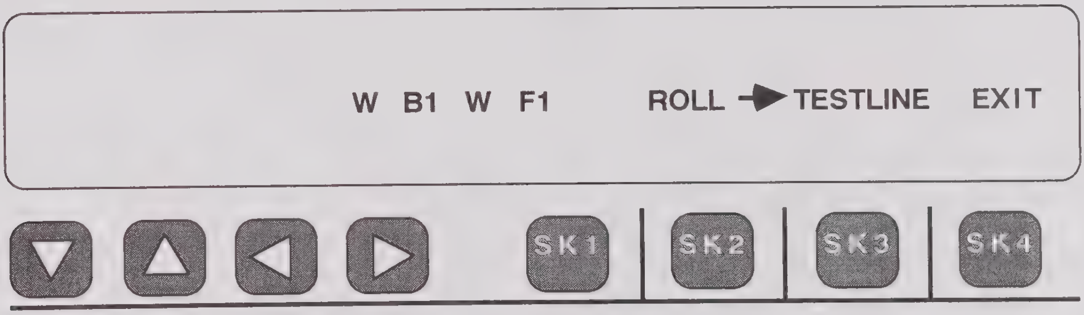
Press "**6**". You will see the display on the following page.



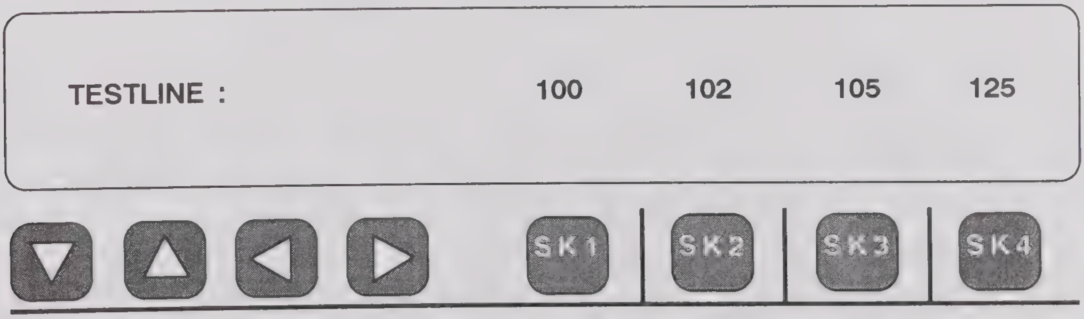
Press “**ENT**” and the display will change to:

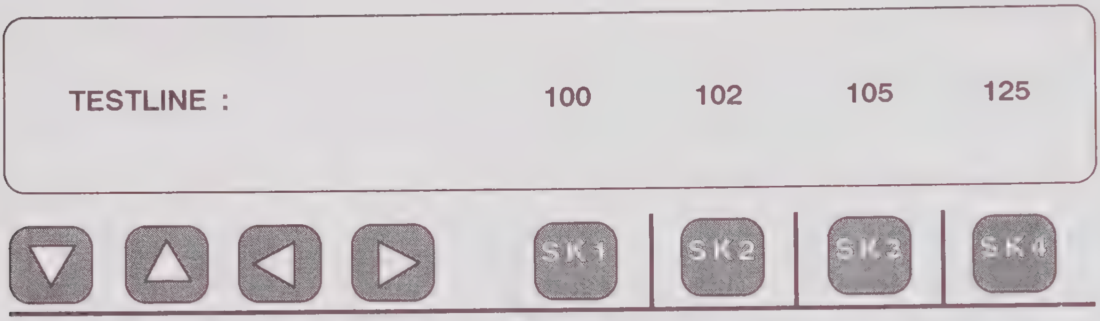


Press Softkey 2 until you see this display:

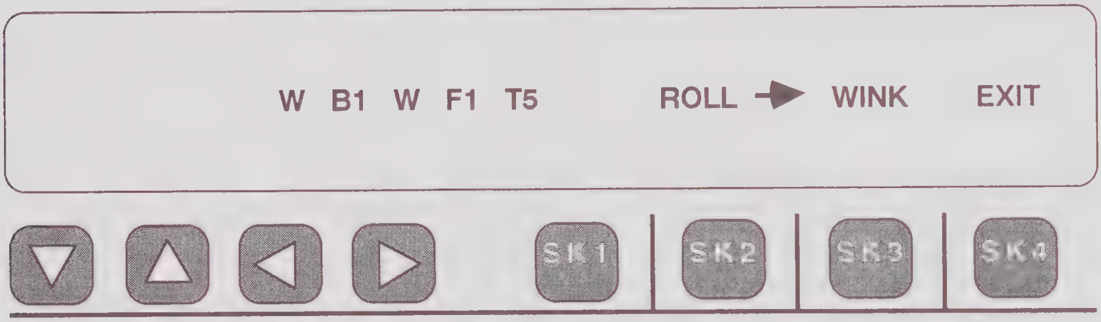


Press Softkey 3 and you will see this display:





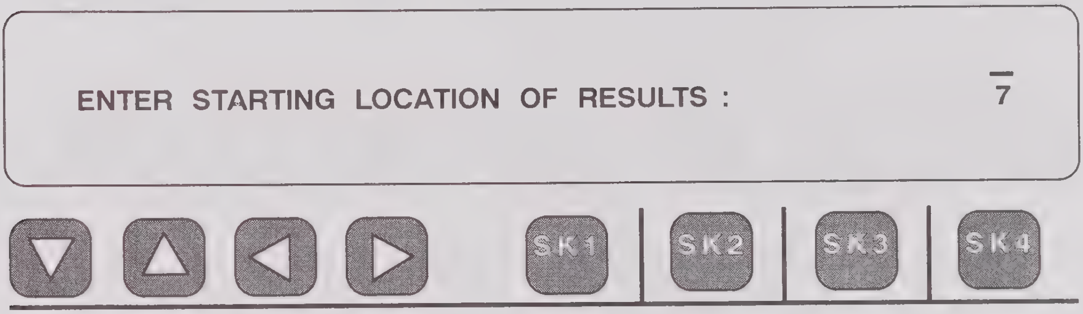
Press Softkey 3 and you will see the display:



This is the complete sequence. It specifies a wink, a batch of telephone numbers starting at location 1, another wink, a fixed telephone number stored in location 6, and a type 105 test line at the end of the call.

4-11.3.3 STORING TEST RESULTS

When the desired sequence has been set up and displayed as shown on page 4-176, press Softkey 4 under **EXIT**. You will see the following display:


ENTER STARTING LOCATION OF RESULTS : $\bar{7}$

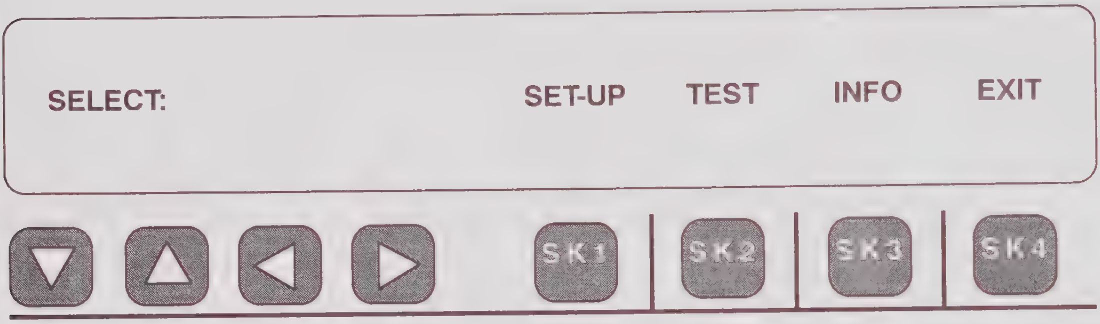
Enter the number of the memory location where you would like the results of the first call to be stored. Subsequent results will be stored into sequential locations. If you are testing five trunks, for example, and begin storing test results in location 10, test results for the first trunk will be in location 10, results for the second trunk will be in location 11, and so on. These results are recalled once batch testing is complete by using the **RCL** and **RCL NXT** keys. More information about recalling test results is contained in the following paragraphs. If your 930A is in PRINTER remote mode, test results will be sent to the printer at the end of each call.

If you do not have enough memory locations to store both the telephone numbers to be dialed and the test results, you may reuse memory locations during a batch test. If you specified a "**1**" as the location to begin storing results in the above example, the results of the first trunk tested would be stored in location 1 overwriting the trunk access code which was formerly stored there. Each subsequent test would overwrite the next location with the results of the next test. Naturally you would have to recall the test results and re-enter the access numbers before running the batch test again. This kind of memory manipulation should only be used as a last resort, as it easily leads to overwriting memory locations you may not intend to overwrite. If the 930A recalls a location that it expects to hold a telephone number, and something else is stored there, the test fails with the result:

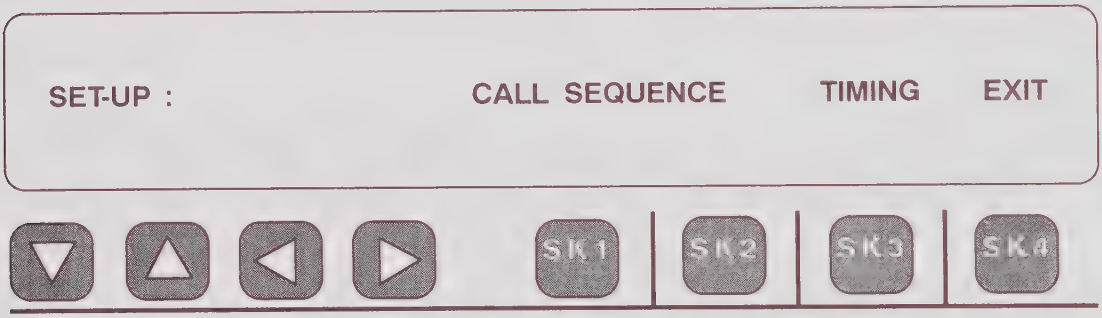
ABORT: NOT DIGIT RECORD

The 930A then proceeds with the next call.

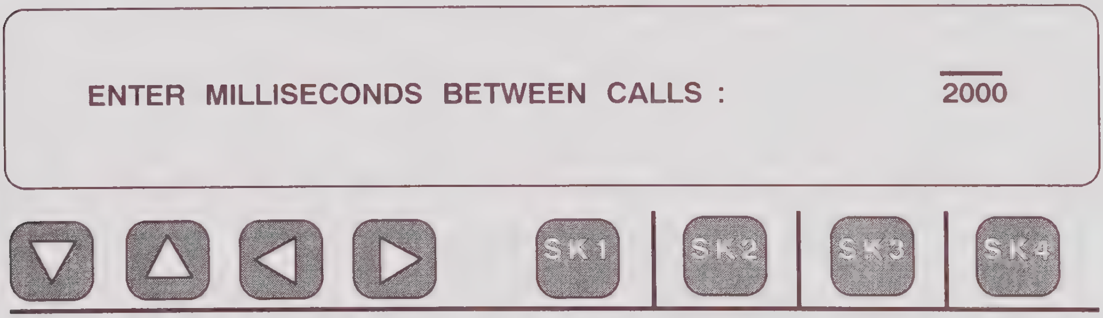
To set up the 930A to store test results, do the following:



Press Softkey 1 under **SET-UP** and you will see the display:

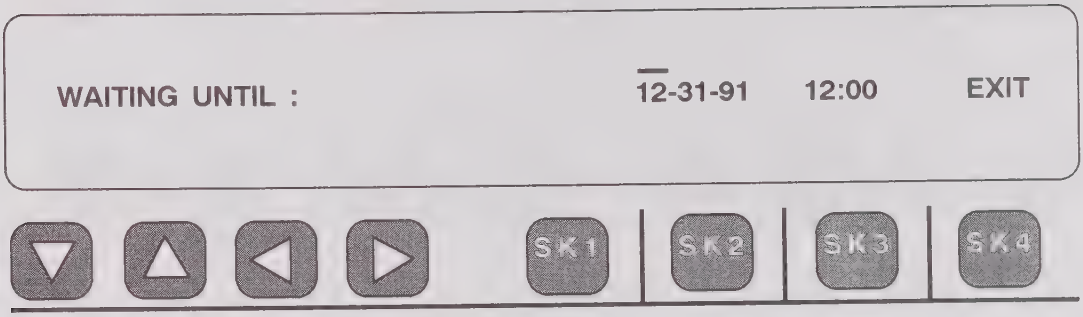


Press Softkey 3 under **TIMING** and you will be prompted:



Use the numeric keypad to enter the number of milliseconds the 930A should remain on hook between calls. The valid range is 10 to 9999 in 10 millisecond increments. Invalid entries will be rounded to the nearest 10 milliseconds. Press the **ENT** key when the number is correct.

The display will advance to appear like:


WAITING UNTIL : 12-31-91 12:00 EXIT

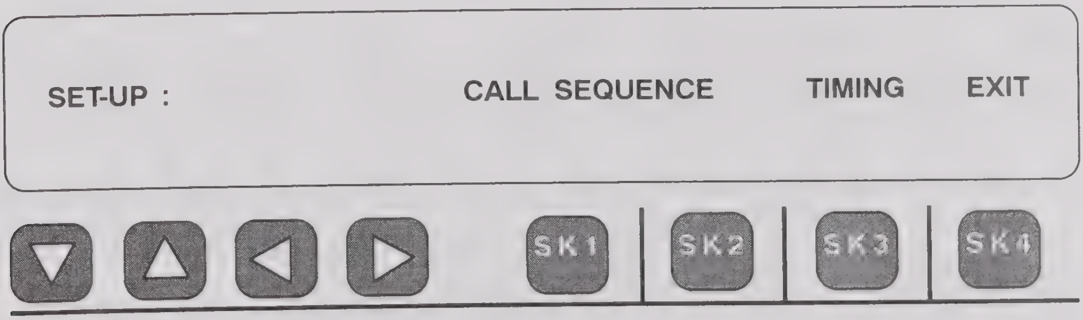
This shows the time and date when the 930A is scheduled to begin its next batch test. You may change it to any time and date you like. If it is set to a time or date previous to the present, testing will begin immediately when you press the softkey under **TEST** in the main select menu.

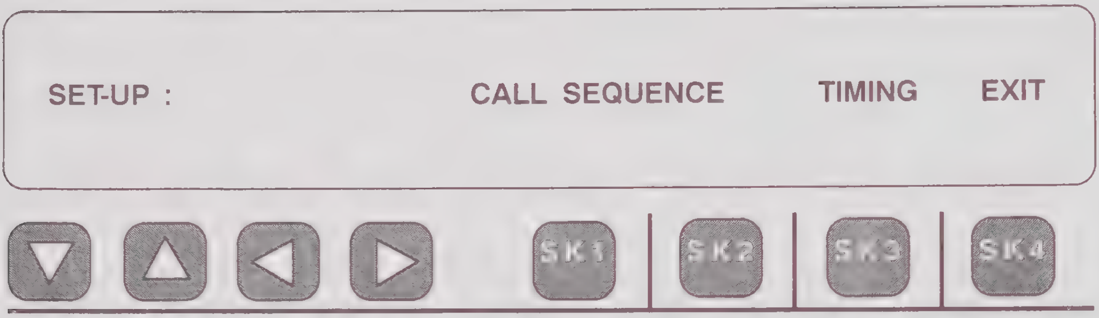
The **UP/DOWN** arrow keys increment and decrement the value of the highlighted field. Months can be rolled from 0 to 12, days can be rolled from 1 to 31, years can be rolled from 0 to 99, hours from 0 to 23, and minutes from 0 to 59.

The **LEFT/RIGHT** arrow keys move the highlight cursor from field to field. The fields are arranged MM-DD-YY HH:mm, where MM is the month, DD is the day, YY is the year, HH is the hour and mm is minutes. Hours are in the twenty four hour, or military, format.

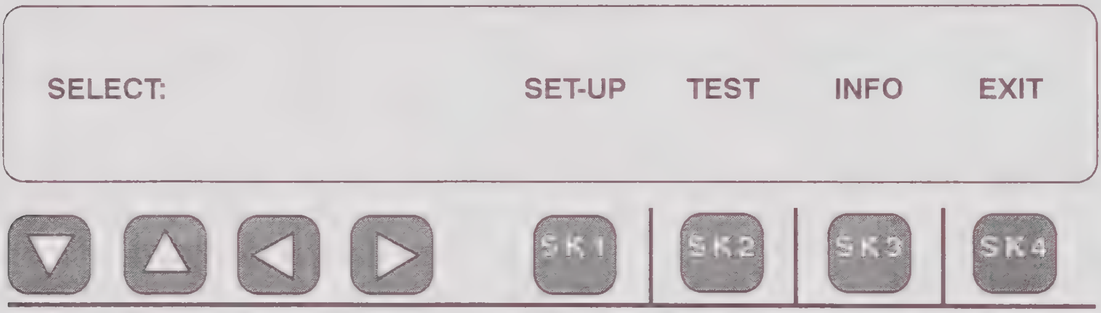
You may use the numeric keypad to directly enter a number into the highlighted field. When you enter a number directly and press the **ENT** key, the highlight cursor automatically advances to the next field.

When the time and date shown correspond to the starting time for batch testing, press Softkey 4 under **EXIT**. The **SET-UP** menu will be displayed:


SET-UP : CALL SEQUENCE TIMING EXIT



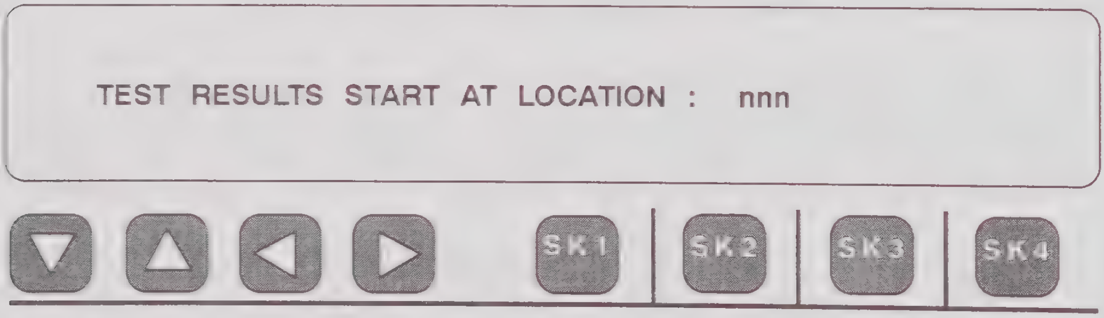
Set-up is now complete. Press Softkey 4 under **EXIT**. The main menu will be displayed:



Press Softkey 2 under **TEST** to begin testing at the time selected.

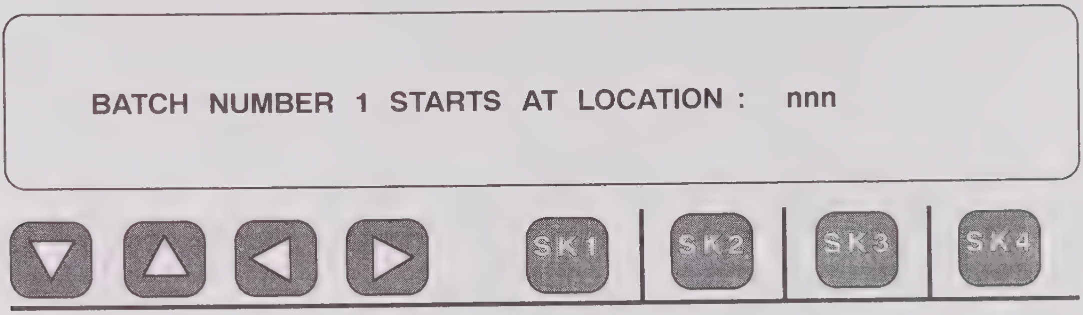
4-11.3.4 HOW TO CHECK THE SET-UP INFORMATION

To check a set-up without re-entering it, press Softkey 3 under **INFO** in the display above. You will see a display such as:


TEST RESULTS START AT LOCATION : nnn

Test results for this batch test will be stored beginning at the location nnn. There will be one set of results for each trunk tested. Test results are stored in sequential memory locations.

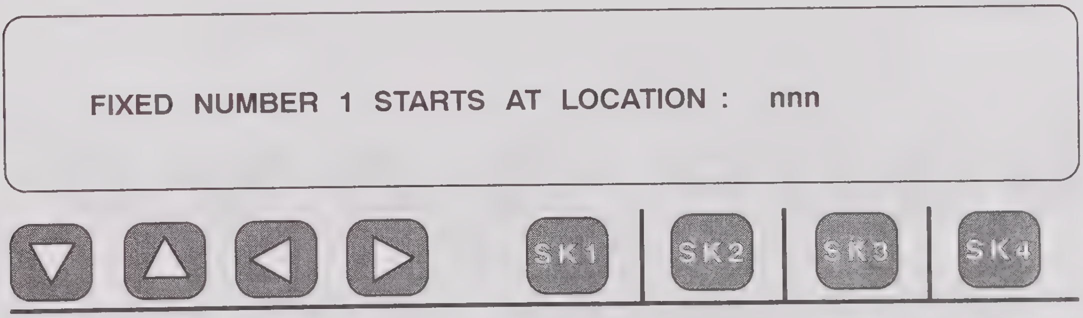
Press any softkey. The display will advance to show:



BATCH NUMBER 1 STARTS AT LOCATION : nnn

The first batch of telephone numbers in the call sequence is stored beginning at location nnn. If there are no batches of telephone numbers in the call sequence, this screen will not appear. If there is more than one batch in the sequence, pressing any softkey will bring up a screen showing the starting location of each one in succession. The sequence may contain up to four batches.

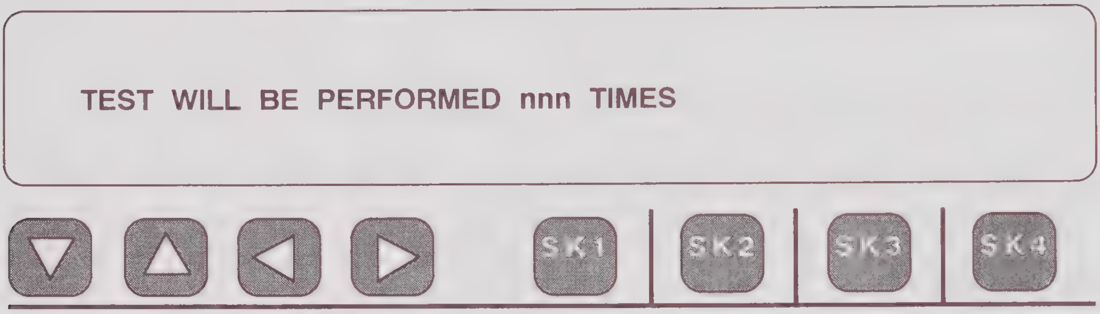
Press any softkey and the display will advance to show:



FIXED NUMBER 1 STARTS AT LOCATION : nnn

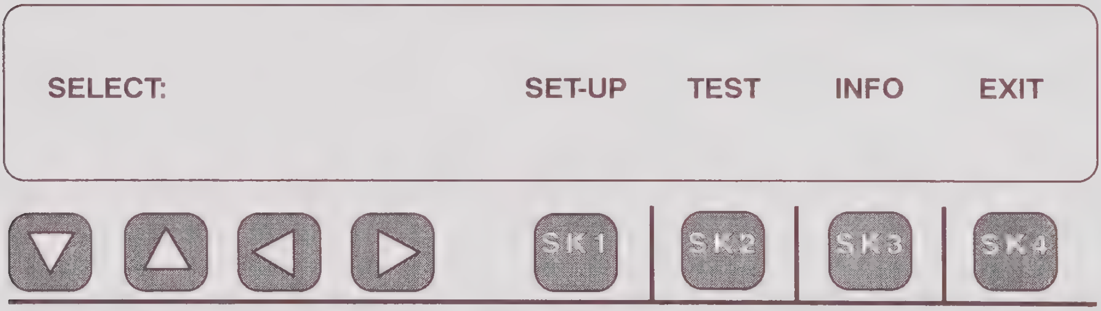
The first fixed telephone number in the call sequence is stored beginning at location nnn. If there are no fixed telephone numbers in the call sequence, this screen will not be displayed. If there is more than one fixed number in the sequence, pressing any softkey will bring up a screen showing the starting location of each one in succession. The sequence may contain up to four fixed numbers.

Press any softkey. The display will advance to show:


TEST WILL BE PERFORMED nnn TIMES

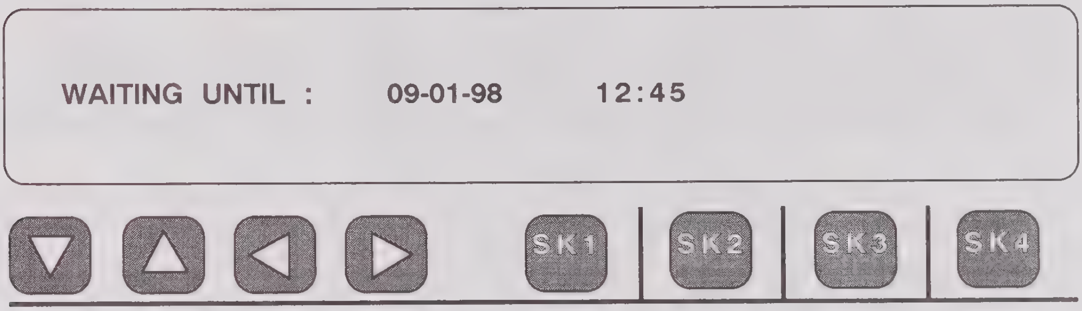
The batch test is set to place nnn calls. If a batch location is part of the sequence, nnn consecutive memory locations must contain telephone numbers for the tests to complete. A total of nnn memory locations will be used to store the test results.

Press any softkey and the display will return to the main menu:


SELECT: SET-UP TEST INFO EXIT

4-11.4 TESTING USING BATCH MODE

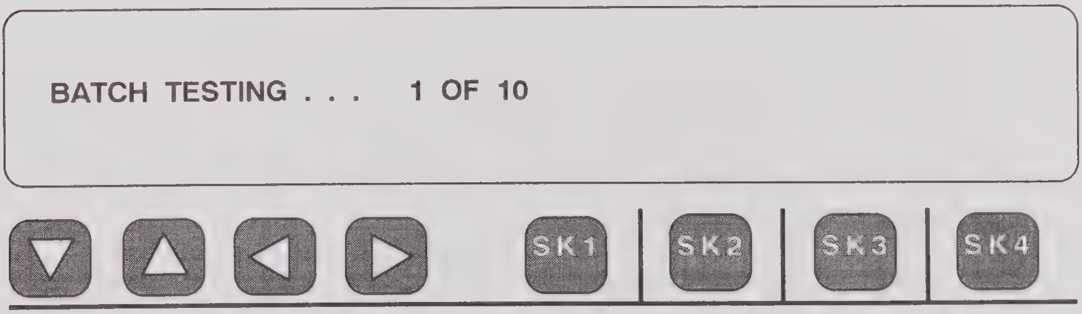
Once you have set up the call sequence and test time, and stored any necessary telephone numbers into memory, you are ready to begin batch testing. Press Softkey 2 under **TEST** in the main menu. You will see a display much like:



WAITING UNTIL : 09-01-98 12:45

This display will remain on the screen until the current time and date are equal to or later than the displayed time and date. Once this occurs, testing will begin. Press any function key to abort batch testing at this time.

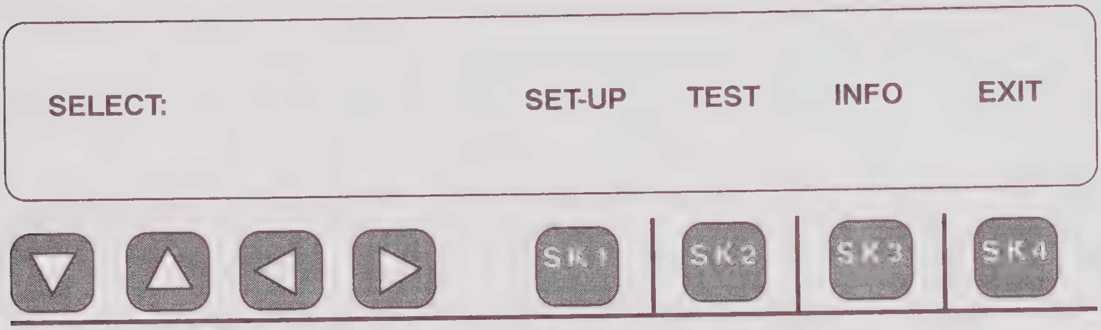
When testing commences, you will see a display such as:



BATCH TESTING . . . 1 OF 10

This display will precede each call and show the current trunk being tested and the total number to test. After this display, various displays may appear, depending on the events in the sequence. Telephone numbers will be displayed while they are being sent, wink timing information will be displayed as it becomes available, call completion status and timing will be shown if the call terminates at a test line, and test results will be displayed as the tests complete. To abort batch testing, press any function key. The test will abort at the end of the current call.

When all the programmed calls have been placed, the display will return to:



Test results are automatically stored into the 930A memory locations specified by the user. If the 930A is in **PRINTER** remote mode, test results will also be sent to the printer as they occur.

4-11.4.1 STORING AND RECALLING TEST RESULTS

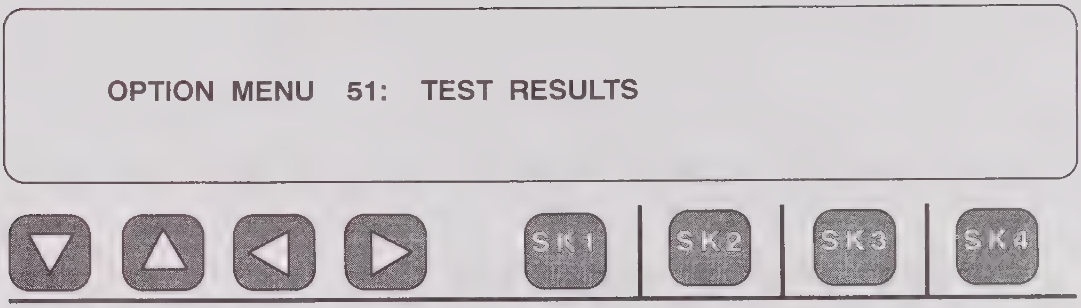
Each call placed in batch mode generates a set of test results. Each set of test results is stored in one of the 930As memory locations. If you have the 64K RAM expansion installed, there are 999 memory locations. The non-expanded 930A has 39 memory locations.

The test results from the first call placed in batch mode are stored in the memory location specified by the user. Results from each subsequent call are stored in the next sequential memory location. For example, if the user tells the 930A to store test results beginning in location 10, the results from the first call are stored in location 10. The results from the second call are stored in location 11 and so on.

When the 930A stores something into a memory location, it overwrites whatever was there previously. The contents of memory locations are stored in battery-backed CMOS RAM and will not be erased by turning off the 930A. You may collect data in the 930A, turn it off, move it to another location, then recall and display the data. Memory contents will remain unchanged unless they are overwritten with new data.

To recall stored test results, use the **RCL** key. To recall test results stored in location 10 for example, press **RCL**, **1**, **0** and **ENT**. This recalls the contents of location 10. To recall the contents of the next sequential register all you have to do is press the **RCL NXT** key.

Whenever you recall batch mode test results, you will see the following display:



OPTION MENU 51: TEST RESULTS

Press any softkey under the display to enter the option menu and examine the results. When you are through inspecting the results, press the **OPTION MENU** key to return to the Option Menu display above. You may then use the **RCL NXT** key to recall the next set of test results.

Since the 930A can be programmed to place a wide variety of calls in batch mode, with many possible results, the contents of Option Menu 51 may vary.

Possible test results are:

DIGITS SENT SUCCESSFULLY

The call was dialed. No winks were timed. No test line was specified.

ABORT: NOT DIGIT RECORD!

One of the memory locations specified as the location of a telephone number did not contain a telephone number. The call failed.

W B1 H WINK 310 MSEC (or a similar display)

A pause for a wink, delay-dial event or an off-hook was specified in the call sequence. No test line was specified, so the highest priority information is wink timing. The call sequence is shown and wink timing information is recorded. See Section 3-10.7 of the manual for wink timing displays and information. If both winks and a test line are specified as part of the call sequence, the wink timing information will be recorded only if a wink fails and the call sequence aborts before the test line can be reached.

ABORT: REORDER 1.7 SECONDS

A test line was specified in the call sequence. The call proceeded to the point where the test line was expected to answer. The call failed to complete. The network response time and call completion status are recorded. The possible call completion states are: **ABORT: REORDER, ABORT: DEAD LINE, ABORT: RINGING (no answer after 60 seconds), ABORT: DIALTONE, ABORT: SPEECH?** and **ABORT: TONE (a continuous tone other than that provided by the expected test line).**

CALL COMPLETE: 3.7 SECONDS

A test line was specified in the call sequence. The call completed successfully. The call completion time is recorded. If any tests were selected, such as loss or C-Notch noise, their results follow. The exact test results will depend on the type of test line and the tests selected.

If the 930A is in **COMPUTER** remote mode, a bell will be sent to the host computer when any of these test results are recalled and Menu Option 51 is entered. Sending a "**W**" to the 930A will cause the 930A to send a report to the computer. Sending an "**X**" to the 930A will cause it to echo its display to the computer. Either method can be used to obtain test results.

If a call sequence includes both a pause for winks (or an off-hook or delay-dial event) and a far end test line, the call completion time and far end test line results will overwrite the wink timing information in **Option Menu 51: TEST RESULTS**. Wink timing for the last trunk tested is available in **Option Menu 9: WINK TIMING**. Wink timing information will only be shown in **TEST RESULTS** if there is no test line specified or the test line could not be reached because an expected supervision event failed.

If you need to record both wink timing and far end test line results on a group of circuits, use **PRINTER** remote mode. The 930A will print out both the wink timing and the test results at the end of each call.

4-11.5 CALLING A 102 TEST LINE (MENU OPTION 29)

Menu Option 29 was added to Batch Mode to allow easy access to type 102 test lines, commonly known as milliwatt lines. These are dial-up test lines that return a nominal 1004 Hz signal at 0 dBm.

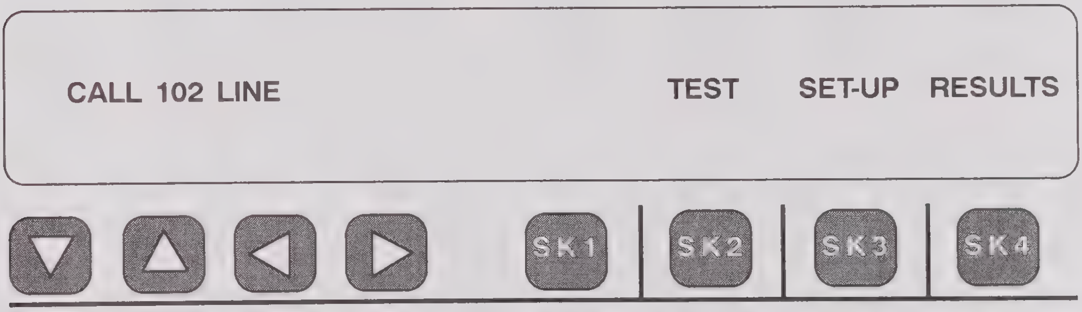
To begin testing, connect the 930A to the trunk under test and select the correct Trunk Type on the instrument. Now do the following:

Press the Option Menu ■ ○ **Option Menu** key.

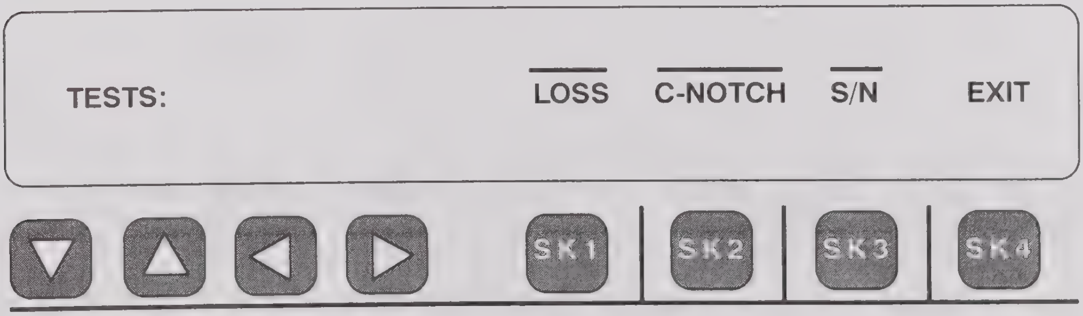
Use the UP/DOWN ▽ △ arrow keys

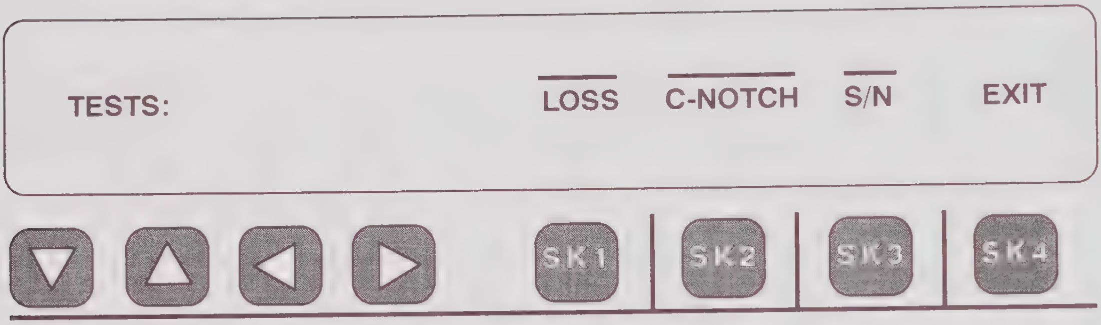
to select Menu Option 29: CALL 102 LINE.

Press any softkey to enter the option and you will see the following display:



If you have not previously set up for a test, press Softkey 3 under **SET-UP**. You will see this display:





LOSS tests loss at 1004 Hz.

C-NOTCH measures C-Notch noise.

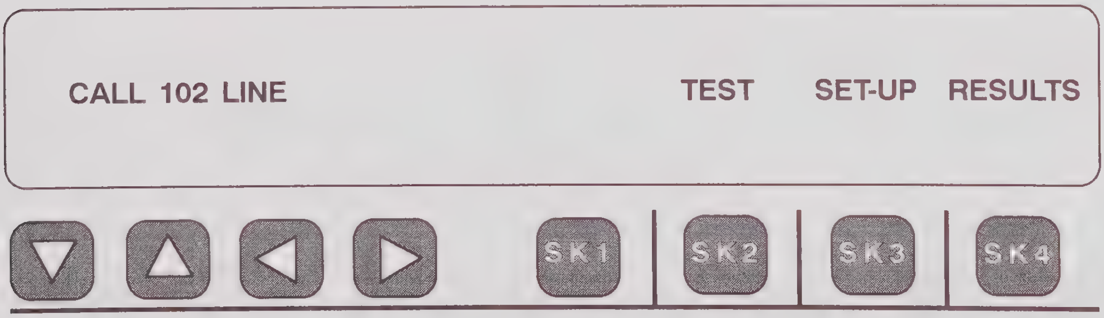
S/N measures signal-to-noise ratio.

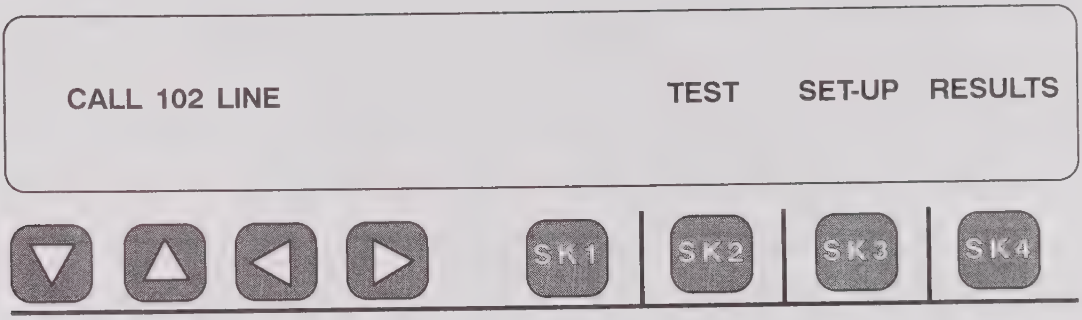
There will be a highlighted cursor over any selected test. Press the softkey beneath the test to toggle it on or off. When the desired tests have been highlighted, press Softkey 4 under **EXIT**.

In COMPUTER remote mode, all previous selections will be cleared when the softkey under **SET-UP** is pressed. Send an ASCII "**J**" to select **LOSS**, an ASCII "**K**" to select **C-NOTCH**, and an ASCII "**L**" to select **S/N**.

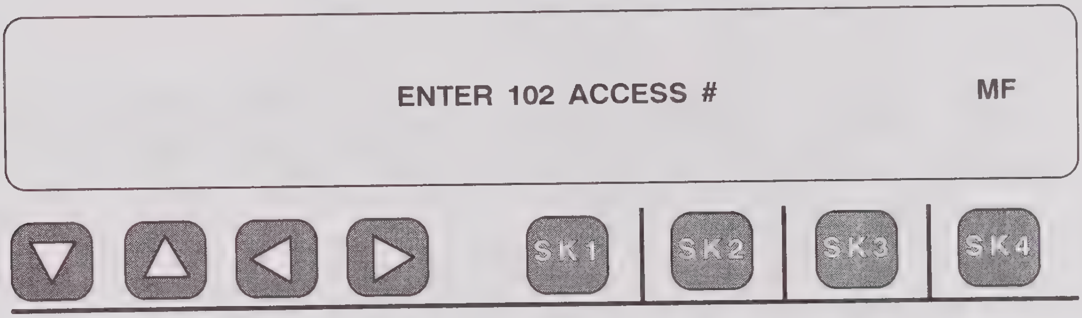
When all the selections are made, press Softkey 4 under **EXIT**. Your set up will be retained in battery-backed CMOS RAM. You will not need to use the **SET-UP** function again unless you wish to change the set up.

You will be returned to the main menu:





When you are ready to begin testing, press Softkey 2 under **TEST** on the main menu display shown above. You will see a display similar to:



The number most recently entered in the **DIAL/RING** mode will usually be displayed. Press the **CLR** (Clear) key to remove any previous entry and return to a display similar to the one above.

Press Softkey 4, labeled **MF**, **DTMF**, or **DP**, to change the outpulsing format to the type required for your circuit. This will also clear any old numbers.

Enter the access number of the far end transponder using the numeric keypad.

Use the front panel Hook Switch to go off hook and begin testing. The 930A will seize the line, send any digits you have entered in the window, and expect the responder at the far end to answer the call. If no number has been entered in the window, no digits will be sent. If the 930A is already off hook when you press **TEST**, it will send any displayed digits immediately. For this reason you should make sure the 930A is on hook before pressing the softkey under **TEST**. In **PRINTER** remote mode, the 930A will send a time and date stamp and the current access number to the printer to identify the test.

It is possible to place a multi-stage call, such as a wink start, equal access, TSPS or CAMA call to a Type 102 test line. Set up for the call using **OPTION MENU 2: SEND DIGIT SEQUENCES** (refer to section 3-10.3) or **OPTION MENU 50: BATCH MODE** (refer to section 4-11) and end the call sequence by selecting **"TESTLINE"** and **"102"**.

After it has sent the displayed digits, the 930A will look for a 1004 Hz tone from he transponder. If it does not receive the tone within 60 seconds, or if it detects busy, reorder, dial-tone or a non-1004 Hz tone (less than 950 Hz or greater than 1050 Hz), it will abort the test with one of these messages:

ABORT: BUSY xx.x SEC
ABORT: REORDER xx.x SEC
ABORT: DIALTONE xx.x SEC
ABORT: TONE xx.x SEC
ABORT: DEAD LINE xx.x SEC
ABORT: RINGING xx.x SEC
ABORT: SPEECH? xx.x SEC

If the 930A successfully detects 1004 Hz within 60 seconds, it will instead display the message: **CALL COMPLETION TIME: xx.x SECS.**

In **PRINTER** remote mode, a copy of the display will be sent to the printer.

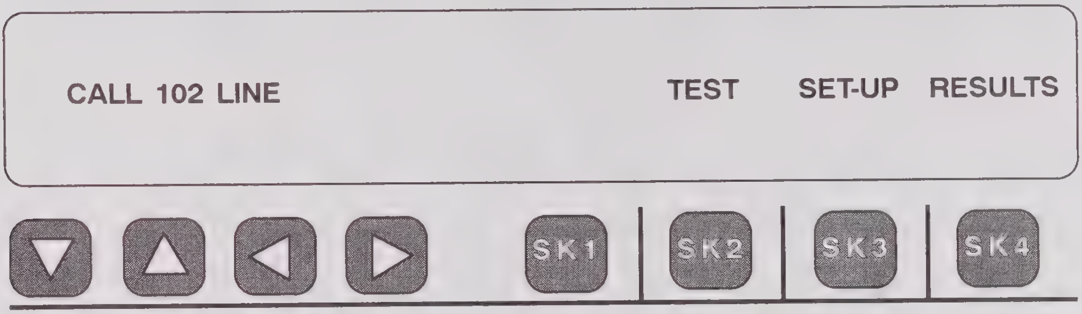
In **COMPUTER** remote mode, the 930A will send a prompt ">" and a bell when it detects 1004 Hz or when it aborts a test. You may inspect the 930A display for the word **"ABORT:"** or **"CALL"** to determine which has occurred. If the display shows **"CALL COMPLETION TIME:"**, the xx.x seconds is the time from the last digit outpulsed to the receipt of the 1004 Hz envelope. If the display shows **"BUSY"**, **"REORDER"**, **"DIAL-TONE"** or **"TONE"**, the xx.x seconds is the network response time. If the display shows **"DEAD LINE"**, **"RINGING"** or **"SPEECH?"**, the xx.x seconds are not significant.

The 930A will now perform the selected tests. The results of each test will be displayed at the end of each test. In **PRINTER** remote mode, the results of each test will be sent to the printer as they occur. In **COMPUTER** remote mode, a bell will be sent to the computer at the conclusion of each test. The test results can be read from the display at that time.

The format of the possible results is:

LOSS:	+nn.n	dB
C-NOTCH NOISE:	nn	dBrnC
SIGNAL/NOISE:	nn	dB

When all the selected tests have been completed, you will be returned to the main transponder display.

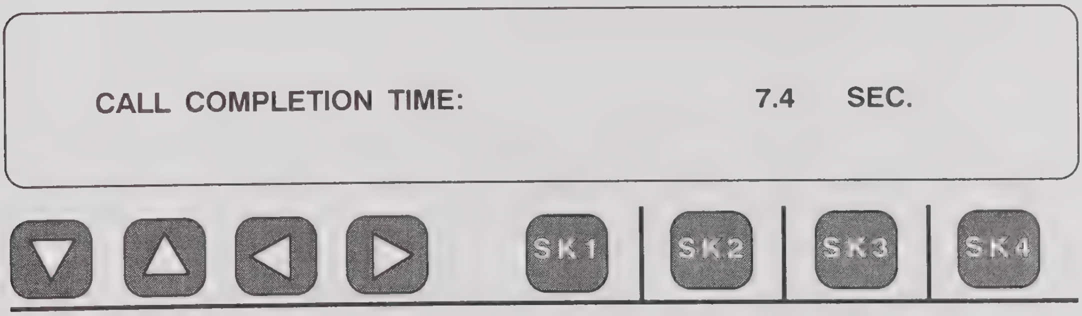


CALL 102 LINE TEST SET-UP RESULTS

If the 930A was in **COMPUTER** remote mode, it sends another prompt when testing is complete.

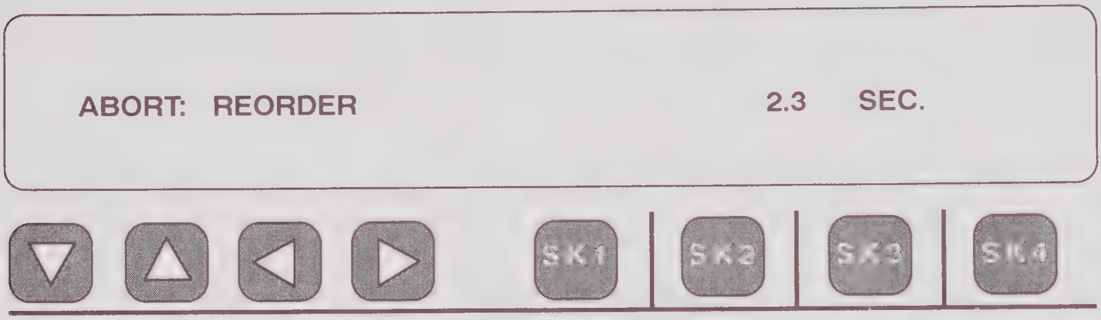
Use the hook switch to put the 930A back on hook and release the telephone line when you finish testing.

To examine the test results, press Softkey 4 under **RESULTS**. You will see either the Call Completion time, such as:



CALL COMPLETION TIME: 7.4 SEC.

or a call failure message, such as:



ABORT: REORDER 2.3 SEC.

If a call failure message is displayed, there are no other results. Press the **OPTION MENU** key to return to the main menu.

If the call completion time is displayed, you are seeing the time elapsed from the last outpulsed digit in the 102 access number to the receipt of the 1004 Hz envelope.

Press Softkey 1 or the **UP/DOWN** arrow keys to scroll through the remaining test results.

4-12 TESTING TO TYPE 125 TRANSPONDERS (OPTION 930A-35)

This option allows you to place test calls to responders that do not use the standard Type 105 format. Specifically, the Hekimian Laboratories Type 125 and 135 transponders.

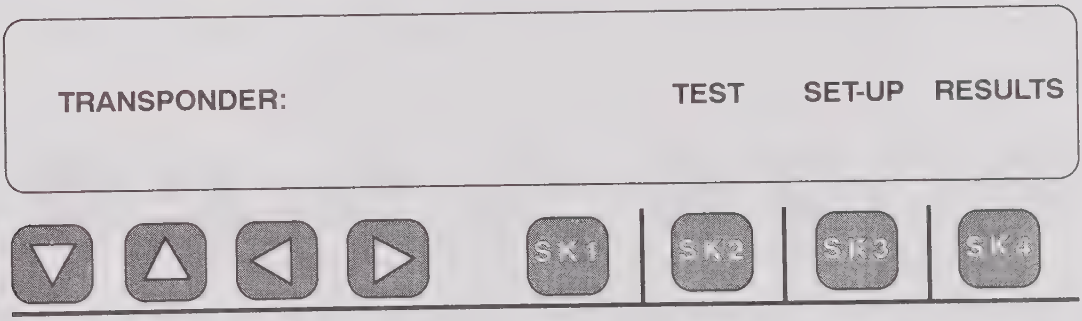
To begin testing, connect the 930A to the trunk under test and select the correct Trunk Type on the instrument. Now do the following:

Press the Option Menu ■ ○ **Option Menu** key.

Use the UP/DOWN ▽ △ arrow keys

to select Menu Option 28: TRANSPONDER TEST.

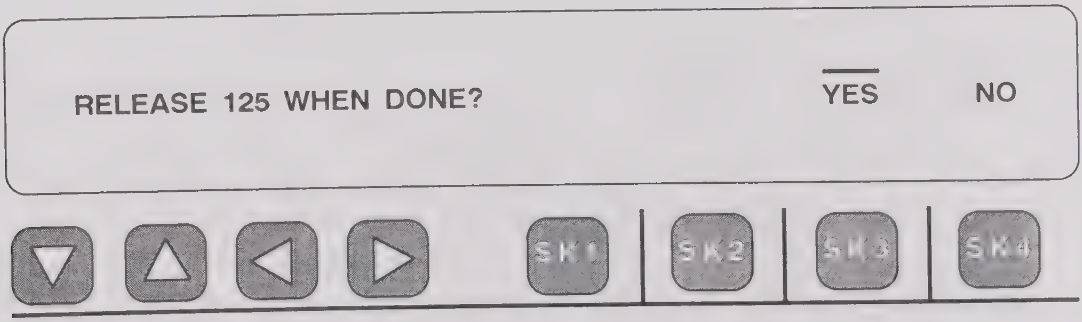
Press any softkey to enter the option and you will see the following display:



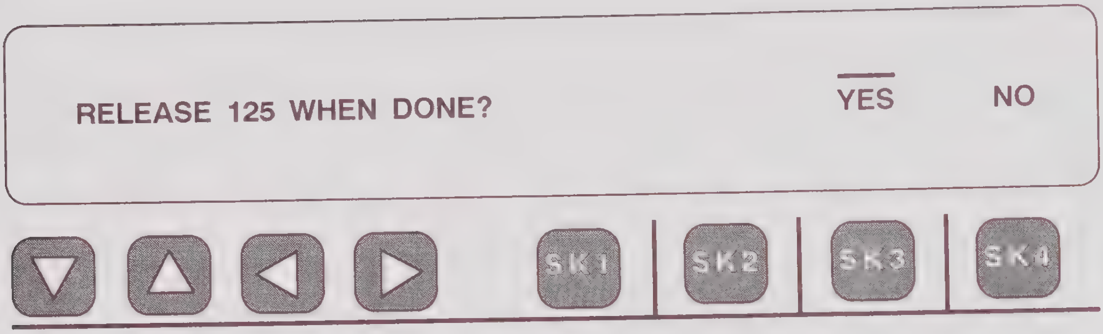
TRANSPONDER: TEST SET-UP RESULTS

4-12.1 HOW TO SET UP MENU OPTION 28: TRANSPONDER TEST

If you have not previously set up for a transponder test, press Softkey 3 under **SET-UP**. You will see this display:



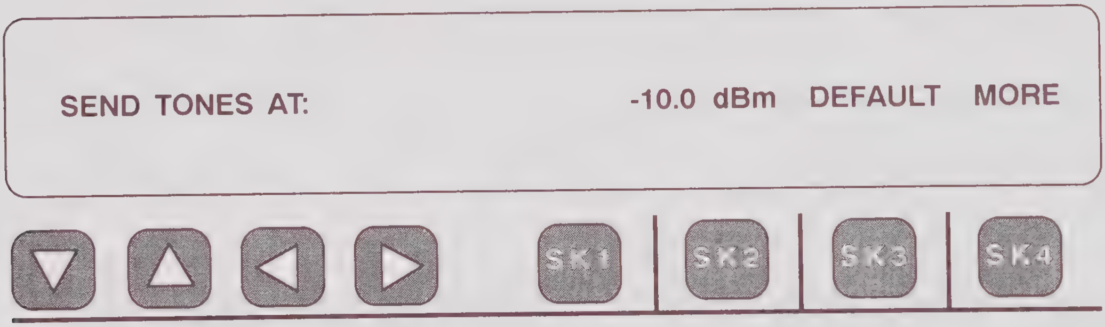
RELEASE 125 WHEN DONE? YES NO



RELEASE 125 WHEN DONE? YES NO

If you press Softkey 3 under **YES**, the 125 transponder will be automatically released after the selected tests are performed. If you press Softkey 4 under **NO**, the transponder will not be released at the end of the tests. This allows you to perform further tests manually.

Once you have pressed either softkey, the display will advance to:



SEND TONES AT: -10.0 dBm DEFAULT MORE

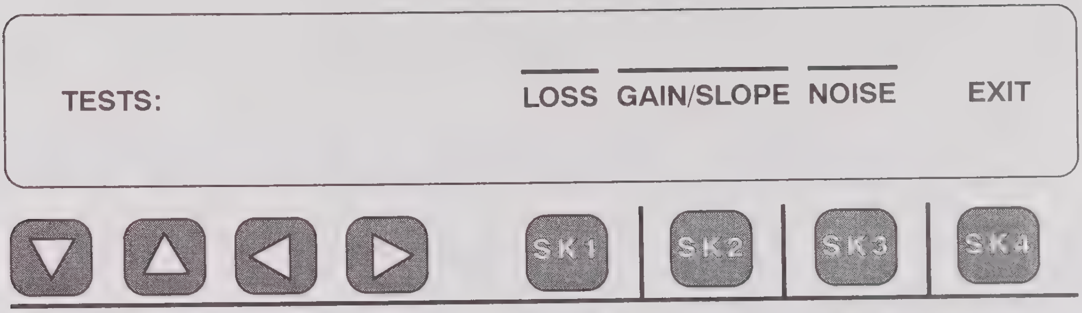
This screen is used to select the level at which test tones will be sent and received. You must set this level to match the level to which the 125 transponder at the far end has been set. Transponders may be strapped to send at either -10 dBm or -20 dBm. The 930A can be set to either of these levels, or to some other level that takes an arbitrary pad into account. For accurate test results, the 930A and the far end transponder must be sending tones at the same level.

Press Softkey 3 under **DEFAULT** to select -10.0 dBm level.

Use the numeric keypad to enter any other level.

Press Softkey 4 under **MORE** to continue with the set-up.

You will then see the test selection screen:



LOSS tests loss at 1004 Hz.

GAIN/SLOPE tests loss at 404 Hz, 1004 Hz and 2804 Hz. The **GAIN/SLOPE** test includes **LOSS**. It is redundant to select them both.

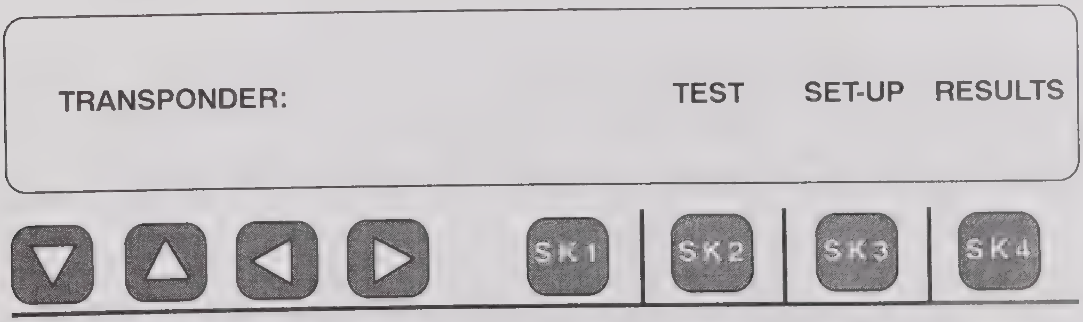
NOISE measures C-Message and C-Notch noise.

There will be a highlighted cursor over any selected test. Press the softkey beneath the test to toggle it on or off. When the desired tests are highlighted, press Softkey 4 under **EXIT**.

In COMPUTER remote mode, all previous selections will be cleared when the softkey under **SET-UP** is pressed. Send an ASCII "**J**" to select **LOSS**, an ASCII "**K**" to select **GAIN/SLOPE**, and an ASCII "**L**" to select **NOISE**.

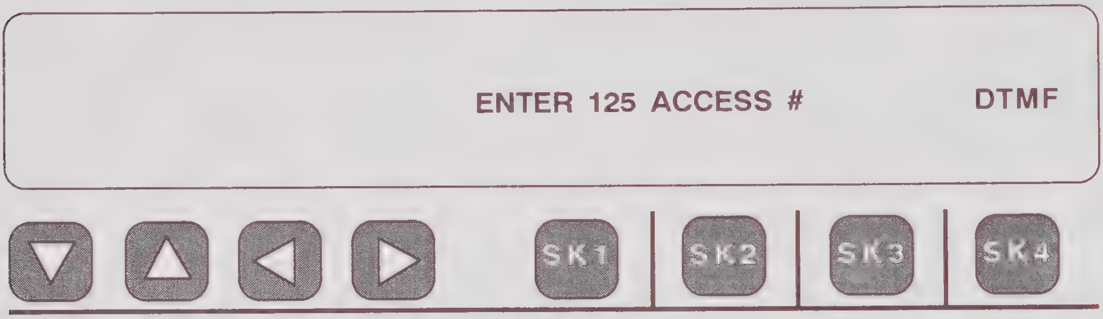
When all the selections are made, press Softkey 4 under **EXIT**. Your set up will be retained in battery-backed CMOS RAM. You will not need to use the **SET-UP** function again unless you wish to change the set up.

You will be returned to the main transponder menu:



4-12.2 HOW TO TEST TO A TYPE 125 TRANSPONDER

When you are ready to begin testing, press Softkey 2 under **TEST** on the main transponder display shown on the previous page. You will see a display similar to:



The number most recently entered in the **DIAL/RING** mode will usually be displayed. Press the **CLR** (Clear) key to remove any previous entry and return to a display similar to the one above.

Press Softkey 4, labeled **MF**, **DTMF**, or **DP**, to change the outpulsing format to the type required for your circuit. This will also clear any old numbers.

Enter the access number of the far end transponder using the numeric keypad.

Use the front panel Hook Switch to go off hook and begin testing. The 930A will seize the line, send any digits you have entered in the window, and expect the transponder at the far end to answer the call. If no number has been entered in the window, no digits will be sent. If the 930A is already off hook when you press **TEST**, it will send any displayed digits immediately. For this reason you should make sure the 930A is on hook before pressing the softkey under **TEST**. In PRINTER remote mode, the 930A will send a time and date stamp and the current access number to the printer to identify the test.

After it has sent the displayed digits, the 930A will look for a 1004 Hz tone from he transponder. If it does not receive the tone within 60 seconds, or if it detects busy, reorder, dial-tone or a non-1004 Hz tone (less than 950 Hz or greater than 1050 Hz), it will abort the test with one of these messages:

ABORT: BUSY xx.x SEC
ABORT: REORDER xx.x SEC
ABORT: DIALTONE xx.x SEC

ABORT: TONE xx.x SEC
ABORT: DEAD LINE xx.x SEC
ABORT: RINGING xx.x SEC
ABORT: SPEECH? xx.x SEC

If the 930A successfully detects 1004 Hz within 60 seconds, it will instead display the message: **CALL COMPLETION TIME: xx.x SECS.**

In **PRINTER** remote mode, a copy of the display will be sent to the printer.

In **COMPUTER** remote mode, the 930A will send a prompt "**>**" and a bell when it detects 1004 Hz or when it aborts a test. You may inspect the 930A display for the word "**ABORT:**" or "**CALL**" to determine which has occurred. If the display shows "**CALL COMPLETION TIME:**", the xx.x seconds is the time from the last digit outpulsed to the receipt of the 1004 Hz envelope. If the display shows "**BUSY**", "**REORDER**", "**DIAL-TONE**" or "**TONE**", the xx.x seconds is the network response time. If the display shows "**DEAD LINE**", "**RINGING**" or "**SPEECH?**", the xx.x seconds are not significant.

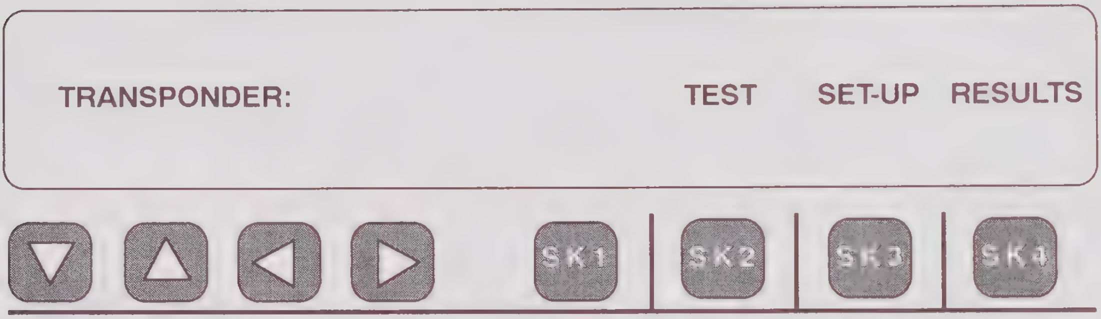
The 930A will now perform the selected tests. The results of each test will be displayed at the end of each test. In PRINTER remote mode, the results of each test will be sent to the printer as they occur. In COMPUTER remote mode, a bell will be sent to the computer at the conclusion of each test. The test results can be read from the display at that time.

The format of the possible results is:

LOSS:	NEAR	+nn.n dB	FAR	+nn.n dB
SLOPE 404:	NEAR	+nn.n dB	FAR	+nn.n dB
SLOPE 1004:	NEAR	+nn.n dB	FAR	+nn.n dB
SLOPE 2804:	NEAR	+nn.n dB	FAR	+nn.n dB
NOISE:	NEAR	nn dBrn	FAR	nn dBrn
NOISE/TONE:	NEAR	nn dBrn	FAR	nn dBrn

The **NEAR** measurement is really the **FAR-TO-NEAR** measurement and the **FAR** measurement is the **NEAR-TO-FAR** measurement. Some transponders do not support the C-Message noise test. In such cases, the NEAR noise measurement will be meaningful but the FAR noise measurement will not. There is no failure indication from the far end for unsupported tests. If unlikely results appear in the FAR noise measurement, consult the documentation provided with your transponder.

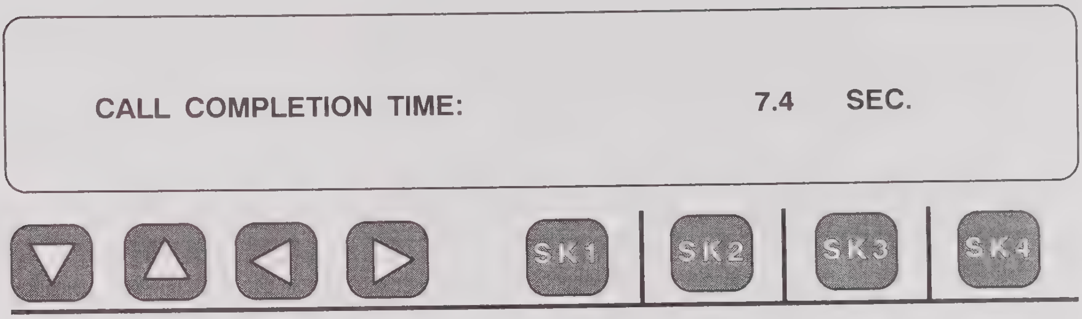
When all the selected tests have been completed, you will be returned to the main transponder display.



If the 930A was in **COMPUTER** remote mode, it sends another prompt when testing is complete.

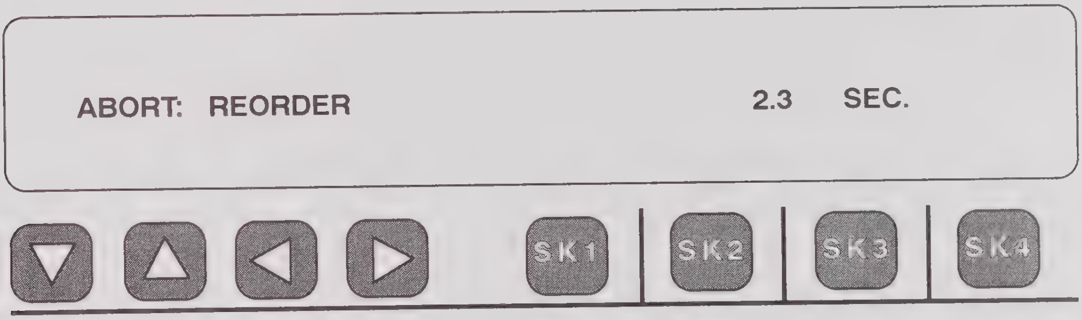
The transponder will be released automatically if you have selected this option in the set up. Otherwise it will remain active. Use the hook switch to put the 930A back on hook and release the telephone line when you finish testing.

To examine the test results, press Softkey 4 under **RESULTS**. You will see either the Call Completion time, such as:



CALL COMPLETION TIME: 7.4 SEC.

or a call failure message, such as:



ABORT: REORDER 2.3 SEC.

If a call failure message is displayed, there are no other results. Press the **OPTION MENU** key to return to the main menu.

If the call completion time is displayed, you are seeing the time elapsed from the last outpulsed digit in the 125 access number to the receipt of the 1004 Hz envelope.

Press **Softkey 1** or the **UP/DOWN** arrow keys to scroll through the remaining test results.

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4-13 USING THE 930A AS AN E911 PSAP SIMULATOR (OPTION 930A-37)

The 930A can be optioned to test the ability of a digital switch to complete Enhanced 911 calls, automatically retry unanswered 911 calls, and transfer 911 calls to the appropriate **P**ublic **S**afety **A**nswering **P**oint (PSAP) on demand.

This option requires that Option 930A-09E be installed as well. Detailed information describing the use and operation of the E911 option is provided in Application Note 3: E911 PSAP Simulator Software.

When installed in the 930A, the E911 option can be found in Menu Option 52: E911 EMULATION.

Refer to Application Note 3, provided in the front pocket of this manual, for details on the operation of this option.

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SECTION V
REMOTE CONTROL OPERATION

5-1 INTRODUCTION

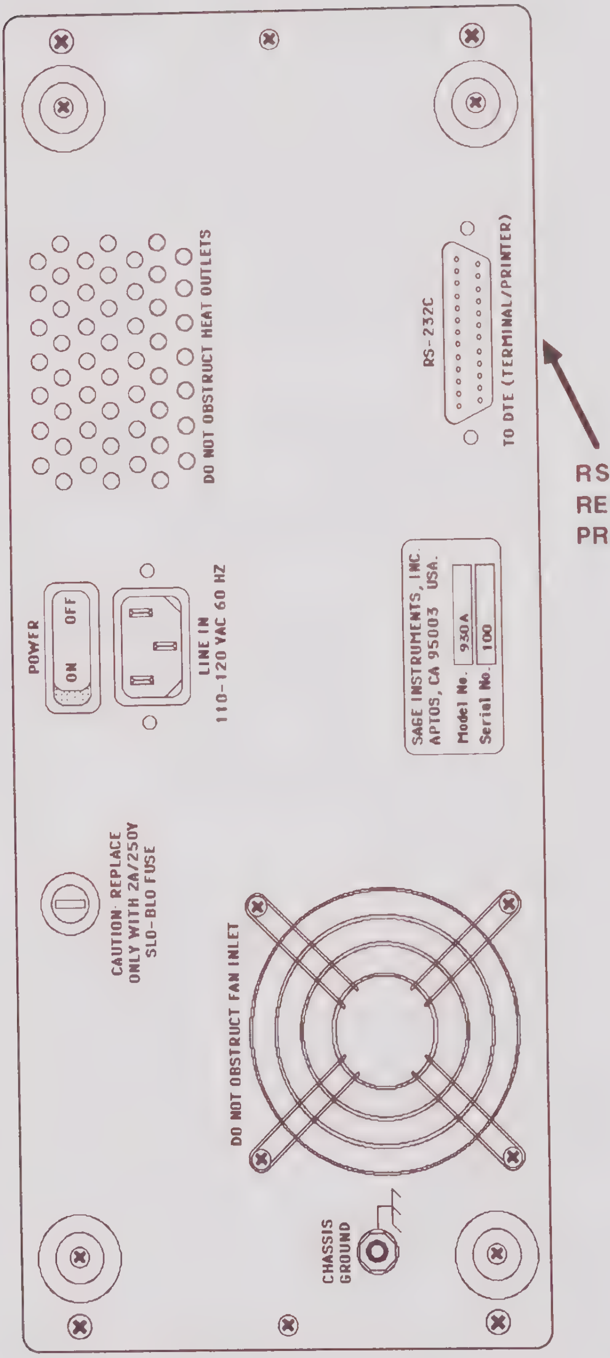
The Model 930A, equipped with Option 930A-10C, can be remotely controlled, or may itself control a printer, through an RS-232C serial port located on the rear panel. The connector is a standard female 25 pin miniature "D" type connector. The mating male connector should be an Amphenol type 206771-1 or equivalent. Refer to Figure 5-1 for the location of the serial port on the rear panel.

The Model 930A has been designed to make operation under remote control as much like manual control as possible. There are no op-codes to memorize. Each front panel key function can be activated by a single ASCII character (a keystroke on the terminal or computer keyboard).

The Model 930A will work with most printers and terminals without modification to cables or reconfiguration of pins. The Model 930A serial interface is configured as Data Communication Equipment (**DCE**) and wants to "see" Data Terminal Equipment (**DTE**) connected to it. Since it is emulating a Modem (**DCE**), most terminals (**DTE**) and printers can be cabled directly to the Model 930A remote port.

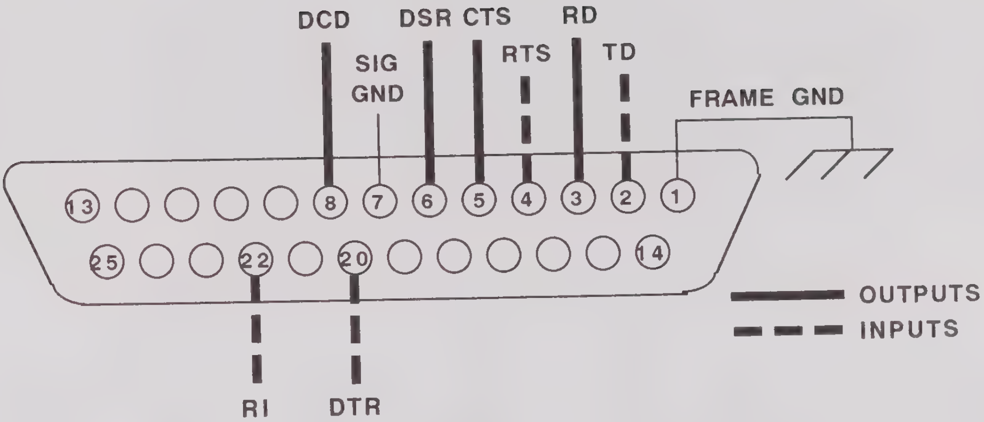
If a computer is being used to control the Model 930A, and it has the capability of being either a **DTE** or a **DCE**, make sure that it is set to **DTE** emulation before connecting it to the Model 930A. If the equipment cannot be configured as **DTE**, then it will be necessary to swap pins 2 and 3 (Transmit and Receive Data). This can be accomplished by using a special cable known as a "NULL MODEM", or a breakout box. The pinouts for the Model 930A connector are shown in Figure 5-2.

Option 930A-10C also provides Real Time Clock. The set-up of the Time/Date clock is described in Section 5-1.3.



RS-232C
REMOTE CONTROL/
PRINTER PORT

RS-232C CONNECTOR LOCATION
FIGURE 5-1



PIN	TO DTE	TO DCE	NAME	FUNCTION
1			FG	FRAME GROUND
2		→	TD	TRANSMITTED DATA
3	←		RD	RECEIVED DATA
4		→	RTS	REQUEST TO SEND
5	←		CTS	CLEAR TO SEND
6	←		DSR	DATA SET READY
7			SG	SIGNAL GROUND
8	←		DCD	DATA CARRIER DETECT
20		→	DTR	DATA TERMINAL READY
22	←		RI	RING INDICATOR

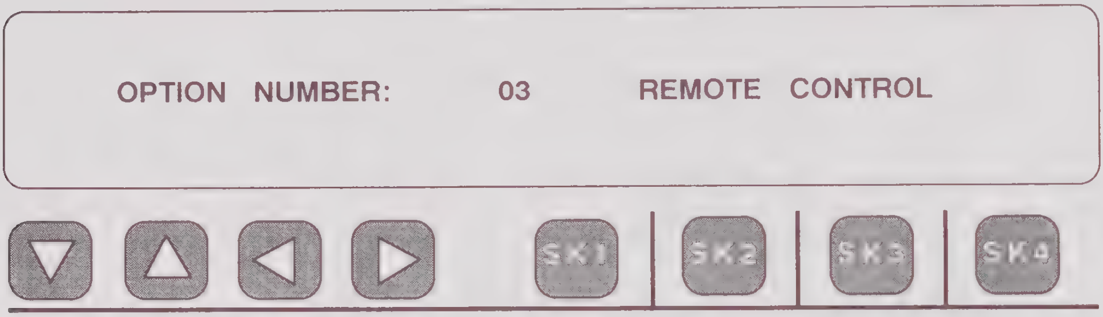
RS-232C CONNECTOR PINOUTS

FIGURE 5-2

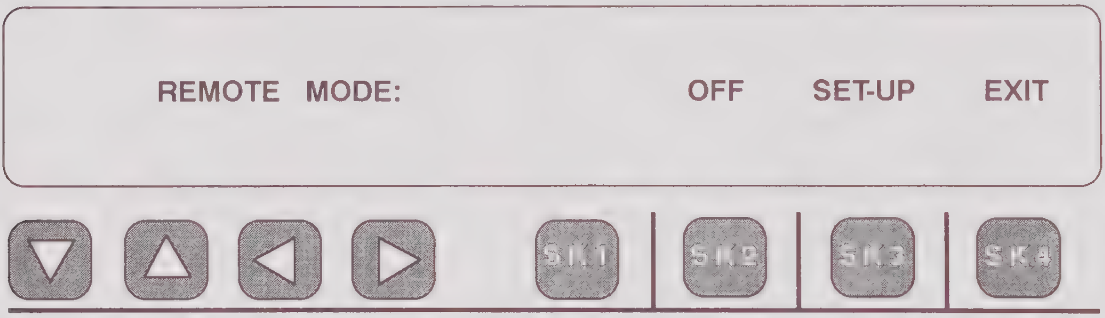
The remaining 15 pins are not connected. **Applying a voltage to pins 1 or 7 will cause damage to the 930A.** The pinouts shown in Figure 5-2 connect directly to a **DTE** (Terminal) or printer. For connection to a **DCE**, a "NULL MODEM" connection, as previously described, must be used.

5-1.1 SELECTING THE REMOTE MODE

To select any of the remote modes, press the **OPTION MENU** key and use the **UP/DOWN** arrow keys to go to Option Menu 3. The display will appear as:


OPTION NUMBER: 03 REMOTE CONTROL

Press any softkey under the display to enter the option:


REMOTE MODE: OFF SET-UP EXIT

If a Remote mode has already been selected, the current mode will be displayed instead of the word **"OFF"**. Pressing Softkey 2 (under **OFF**) pages through the Remote Modes. The modes available with Option 930A-10C RS-232C Remote are:

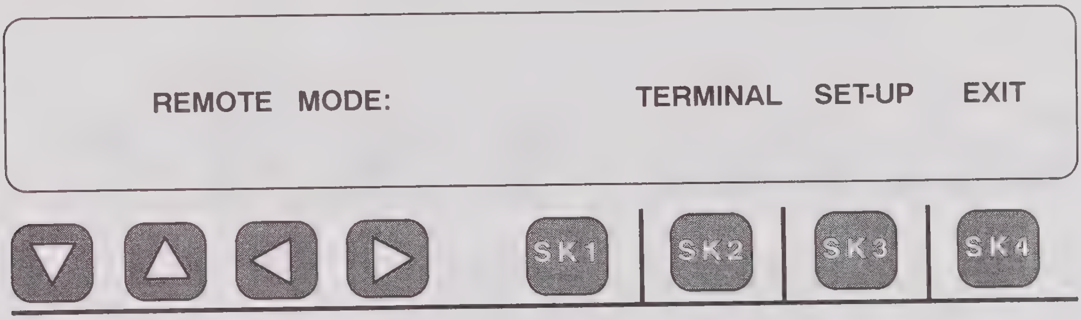
"OFF" ----------	Manual control
"TERMINAL" -----	For use with dumb terminals
"COMPUTER" -----	For use under computer control
"PRINTER" -------	Used to drive any serial printer connected to the RS-232 serial port.

Other modes displayed are custom remote modes for a particular customer. Selecting one of these modes will have no effect if they have not been installed in the unit. Press Softkey 2 until the desired mode appears. Press Softkey 4 (under **EXIT**) and the current mode will be initialized.

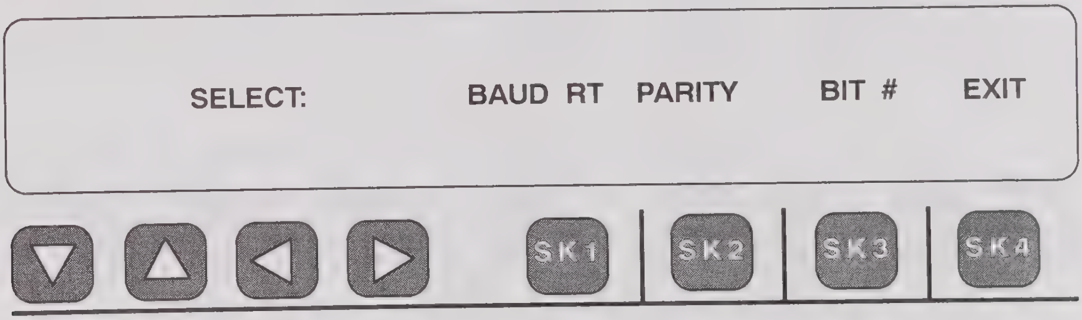
Make sure that the current mode is **"OFF"** to operate the 930A in the manual mode. Pressing Softkey 1, under the words **"REMOTE MODE"**, puts the 930A into **STANDBY MODE**. Use **STANDBY MODE** to operate the 930A manually without losing remote access capability. Press Softkey 1 again to disable **STANDBY MODE**. When the correct remote mode has been selected (either **"TERMINAL"**, **"COMPUTER"** or **"PRINTER"**), the 930A's serial interface must be set to match the equipment connected to it.

5-1.2 SETTING THE SERIAL INTERFACE FORMAT

Inside Menu Option 3 (**REMOTE CONTROL**), the main display appears as:



Pressing Softkey 3 (under **SET-UP**) brings up the display shown below:



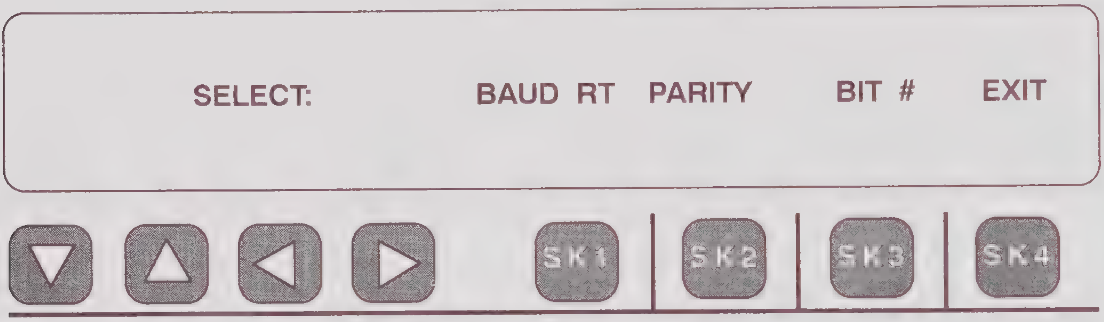
The **SET-UP** menu is used to adjust the baud rate, parity, and number of data bits of the 930A's asynchronous RS-232C serial interface to match the data format of any Terminal, Computer, or Printer connected to the 930A. The settings are retained in non-volatile memory and need not be changed unless a new item of equipment is connected to the 930A. Pressing Softkey 4 (under **EXIT**) exits the menu.

NOTE: The 930A is factory preset to a data format of 9600 baud, even parity, 7 data bits and 1 stop bit. The 930A returns to these defaults if a **"Cold Boot"** is performed. Otherwise, the 930A will retain any new settings you enter, even when power is turned off, until they are changed.

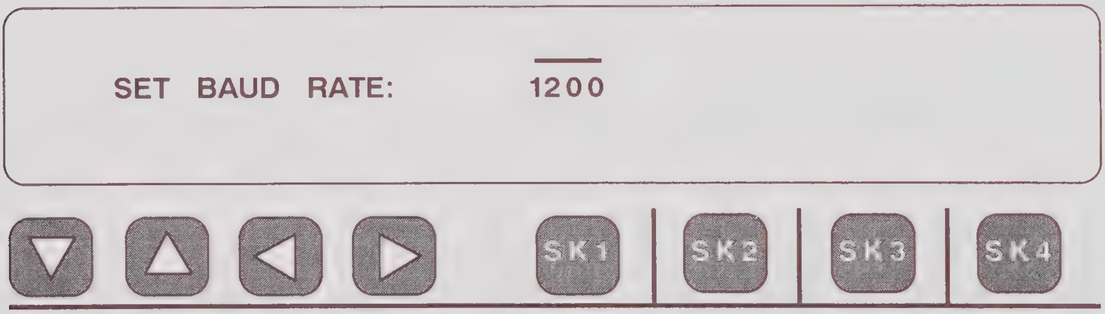
The following step-by-step procedure illustrates the set-up of the data format and is applicable to any of the modes.

EXAMPLE:

Starting from the point at which the **SET-UP** menu is entered by pressing Softkey 3, the main **SELECT** display appears as:



To change the BAUD RATE, press Softkey 1 (under **BAUD RT**). An example display is shown below (the rate may differ):

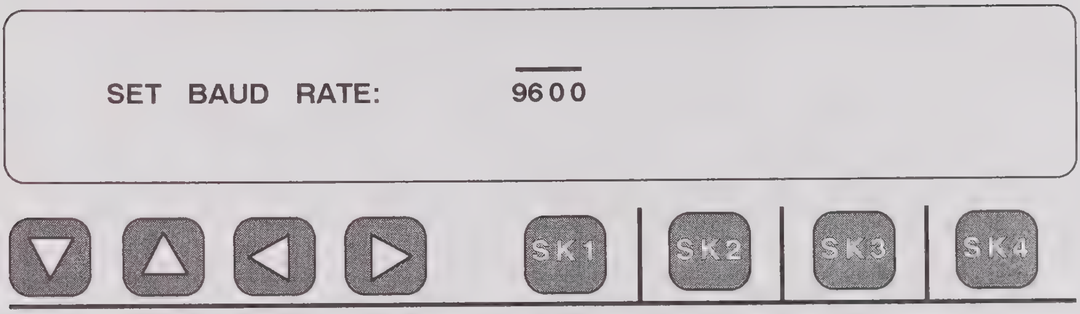


In this example, a value of 1200 baud is shown. If you wanted to keep this rate, you would press the **ENT** (Enter) key, or any softkey, to accept it. **To change the rate**, use the keypad to enter the new value between 110 baud and 9600 baud. **Whenever possible, use the 9600 baud rate to minimize transmission lag.**

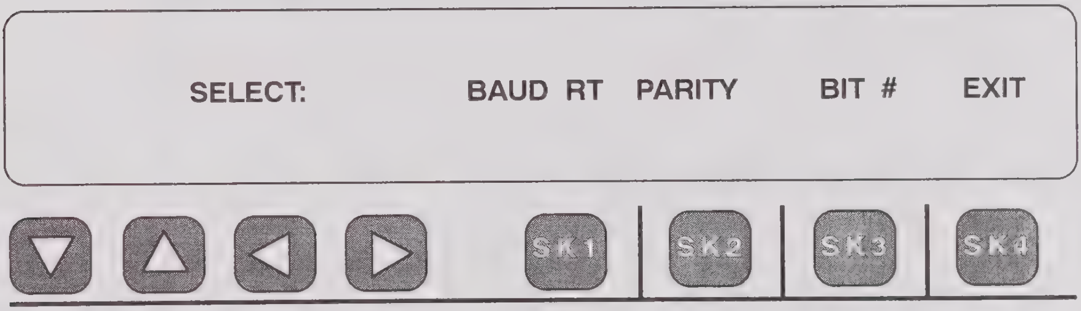
To operate at 9600 baud, instead of the 1200 baud displayed, do the following:

Press **9** then **6** then **0** then **0**

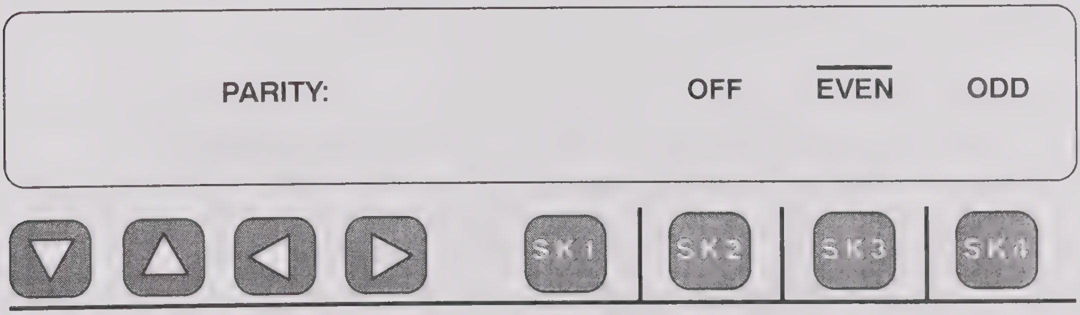
The display of the 930A changes to:



Press ENT to enter the rate and return to the Set-Up Menu.



To change the PARITY, press Softkey 2 (under **PARITY**) to bring up the following display:



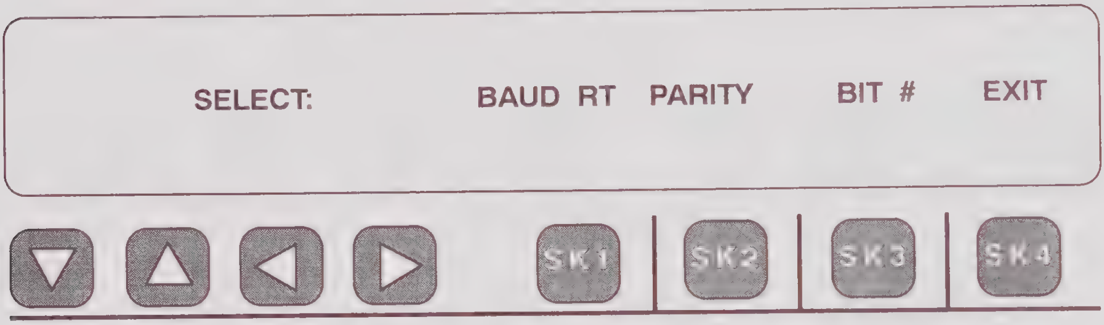
A cursor appears over the current parity state (**EVEN** in this example).

Press Softkey 2 (under **OFF**) for **No Parity**

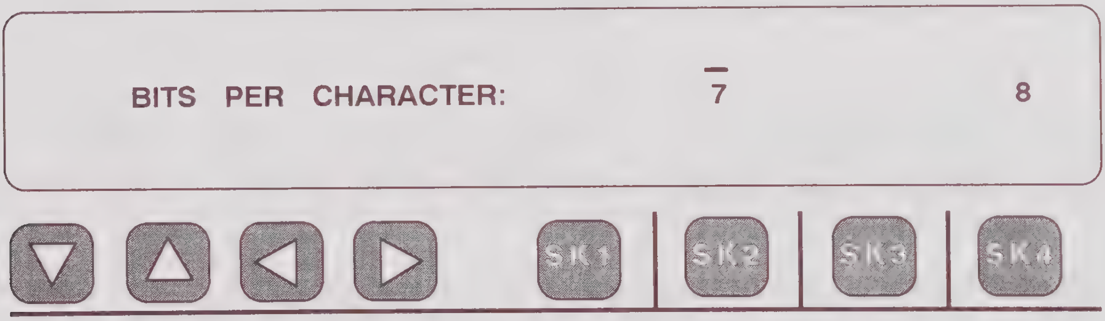
Press Softkey 3 (under **EVEN**) for **Even Parity**

Press Softkey 4 (under **ODD**) for **Odd parity**

Once you have pressed the softkey under your choice, the 930A will revert to the **SELECT** menu.



To change the DATA FORMAT, press Softkey 3 (under **BIT #**) and the following display will appear:



A cursor appears over the currently selected number of data bits (**"7"** in this example).

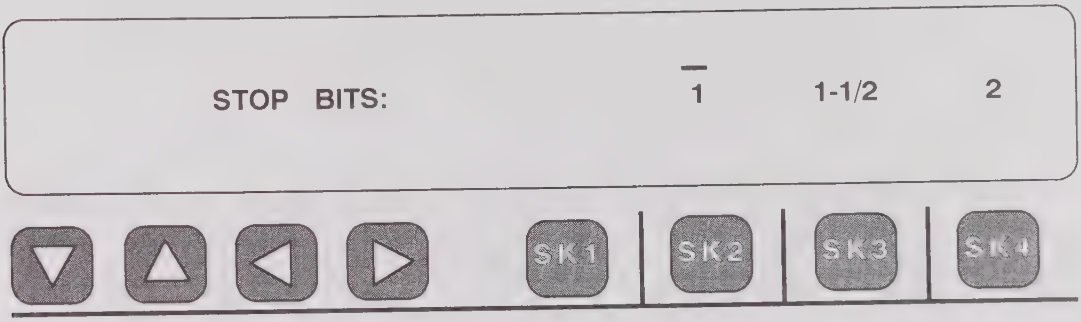
The 930A supports ASCII data formats of 7 or 8 bits length, and 1, 1-1/2 or 2 Stop bits. **To change the currently selected data format,**

Press Softkey 2 (under **7**) to select 7 bit ASCII code.
Press Softkey 4 (under **8**) to select 8 bit ASCII code.

NOTE

"Highlighted" characters (those with a cursor above them in the 930A's display) are sent with bit eight (**MSB**) set. Some printers and terminals treat characters with bit eight (8) set as graphics characters. SAGE recommends seven (7) data bit length for use with printers and terminals.

When the appropriate ASCII word length has been selected, the display will advance to read:



A cursor appears over the currently selected number of stop bits ("1" in this example).

Press Softkey 2 (under **1**) to select **1 Stop bit**.
Press Softkey 3 (under **1-1/2**) to select **1-1/2 Stop bits**.
Press Softkey 4 (under **2**) to select **2 Stop bits**.

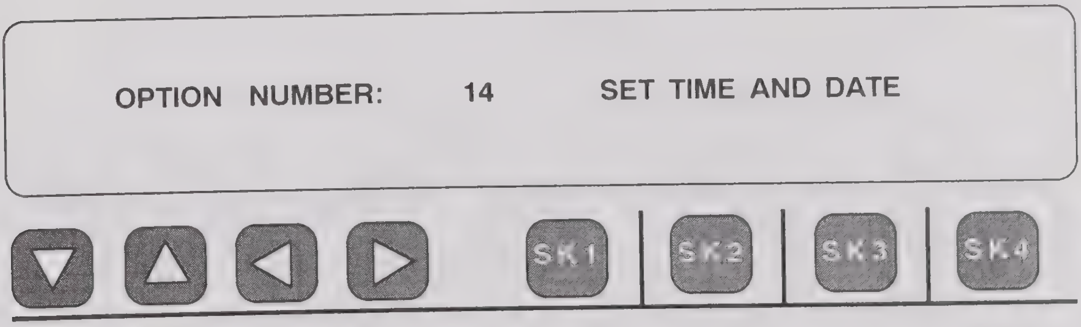
One stop bit is the most common setting. The 930A will automatically return to the **SET-UP** menu after the selection has been made.

5-1.3 SETTING THE TIME AND DATE

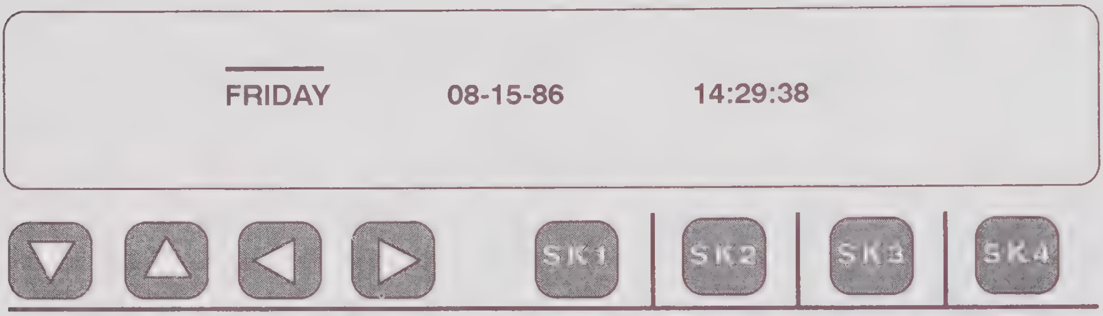
To set the Time and Date, perform the following steps:

Press the OPTION MENU ○ **Option Menu** function key.

Use the UP/DOWN arrow keys to select Menu Option 14, SET TIME AND DATE.



Press any softkey under the display and the currently stored time and date will be displayed. The cursor always appears over the day of the week.



Use the LEFT/RIGHT ◁ ▷ arrow keys

to position the cursor over the day, date or time parameter it is desired to change.

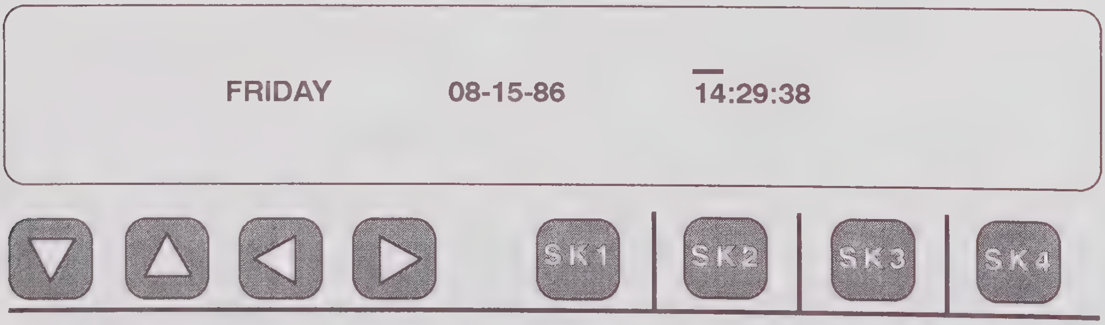
Use the UP/DOWN ▽ △ arrow keys

to change the parameter under the cursor.

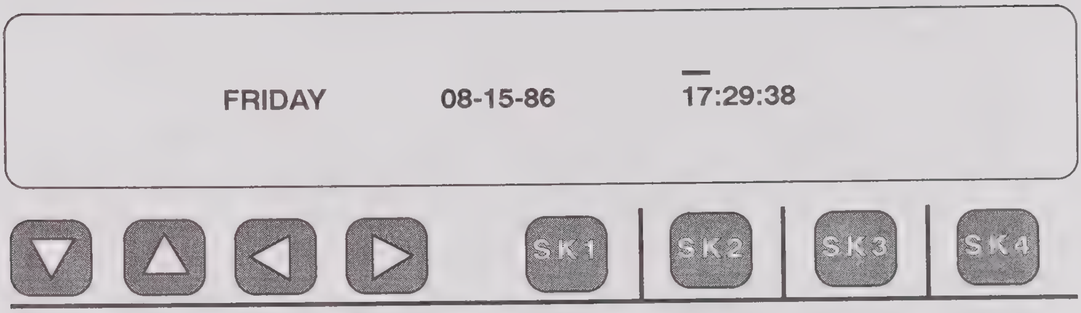
For parameters other than the day of the week, you may enter a number directly using the keypad and the **ENT** key. The cursor will automatically advance to the next field.

As an example, suppose it is desired to advance three hours to compensate for a time zone change from west coast to east coast time.

Use the **RIGHT** Arrow key to position the cursor over the **"14"** as shown:



Use the **UP** arrow key to advance the hour to **17** as shown below:



When the correct time and date have been set, press the **OPTION MENU** key to exit.

5-2 USING THE 930A IN THE PRINTER MODE

5-2.1 INTRODUCTION

The Model 930A will work with most commonly available printers provided that the following conditions are met. The printer must have an Asynchronous RS-232C serial input port, print both upper and lower case, be ASCII compatible, and have a carriage width of at least 50 characters (preferably 80 characters). For optimum performance, the printer should accept input at 9600 baud, have at least a 2K buffer, and accept continuous feed paper. Sage Instruments currently recommends the Okidata 182 with Super Speed Serial Interface. You may obtain a printer from Sage by purchasing accessory 9400-0001-01 (80 Column Printer and Cable) if you are unable to obtain one locally.

Care must be exercised when attempting to use printers which do not have buffers. Such printers must be run at a speed at, or below, their print speed multiplied by a factor of 10. That is, an unbuffered printer with a print speed of 30 cps must be run at or below 300 baud, and an unbuffered 120 cps printer would have to be run at, or below, 1200 baud. If your printer cannot keep up with the 930A, switch to a lower baud rate or use one of the printer flow control hand shakes described in section 5-2.2.1. Hard copy terminals, such as Teletypes and DECwriters, may also be used as printers, but their low speed tends to degrade 930A performance to an undesirable extent.

While the 930A can be connected to most serial printers without modification or special cables, experience has shown that printers vary widely in terms of interface requirements. Some may require special cables or an adaptor. Refer back to Figure 5-2 for the pinouts of the 930A serial interface.

5-2.2 SETTING-UP THE PRINT FUNCTION

The procedure for setting up the 930A to work with a serial printer is similar to the procedure for setting up any of the remote operating modes. For this reason a brief review of the general set-up procedure follows:

1) Turn on the 930A, set-up the correct Trunk Type (Section 3-4), and any test functions desired (Refer to Section 3 or 4 as necessary).

2) Press the **OPTION MENU** key, page to Menu Option 3 (Remote Control), and set the mode to **"OFF"** (Refer to Section 5-1.1 as necessary). Exit back to the main Option Menu by pressing Softkey 4 (under **EXIT**). This step prevents inadvertent dumping of data to the printer and filling up its buffer before you are ready to print.

3) Turn on the Printer and connect its cable to the 930A serial port.

4) Press the **OPTION MENU** key and enter Menu Option 3 by pressing any softkey under the display.

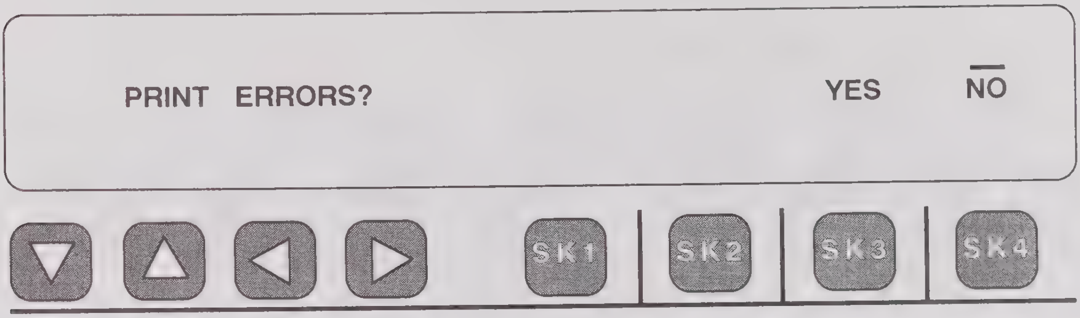
5) Once inside Menu Option 3, press Softkey 3 (under **SET-UP**).

6) If the printer's data format is not known, it can be determined from it's operating instructions. Set the 930A's baud rate, parity, character size and stop bits to match those of the printer (Refer to Section 5-1.2 as necessary).

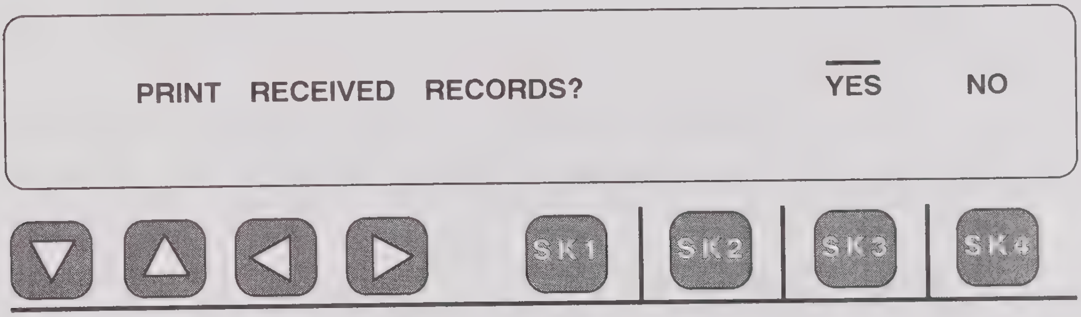
7) Once the data format has been set correctly, and the 930A has returned to the Remote Control menu, press Softkey 2 until the display reads **"PRINTER"**.

8) Exit from the Remote Control menu by pressing Softkey 4 (under **EXIT**) and the Printer mode will be initialized.

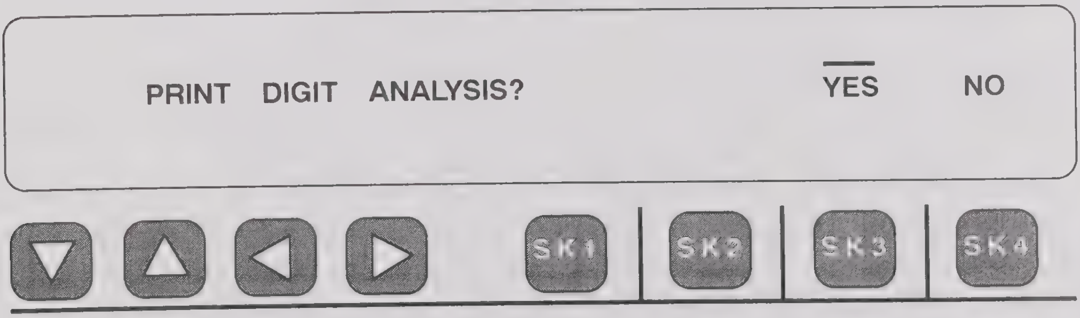
At this point, you will be asked a series of questions by the 930A regarding what parameters are to be printed out. These questions are:



To print PCM errors, whenever they occur, press Softkey 3 (under **YES**), otherwise press Softkey 4. In either case the 930A display will advance to the next question, which is:

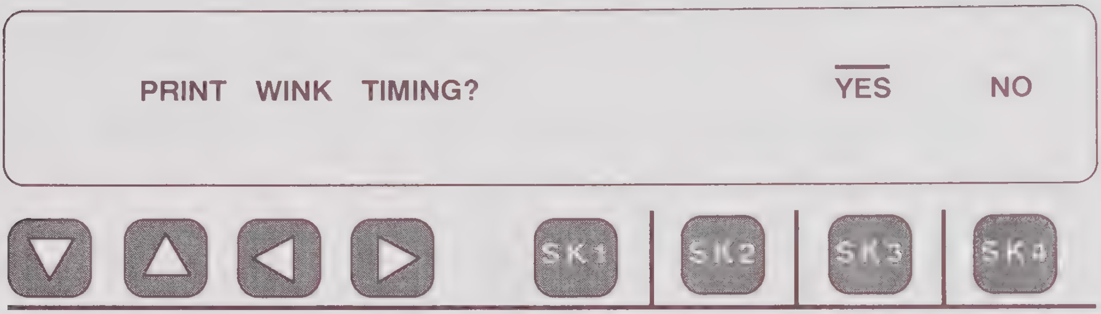


To print calls captured by the digit receiver, press Softkey 3 (under **YES**). Press Softkey 4 if this printout is not wanted. If you answer **YES**, the display advances to:



To print the analysis of the received digits, press Softkey 3 (under **YES**), otherwise, press Softkey 4.

The 930A display advances to the next question which is:



To print the wink timing measurements, press Softkey 3, otherwise press Softkey 4. When the questions have been answered, you may **exit** from this Menu Option. The printer will begin to print whenever one of the conditions occurs, or if the **ENT** (Enter) key on the 930A is pressed. Press the ENT key to test your connection. If the output is garbled, adjust the baud rate, parity, or number of bits. To suspend printing for any reason, without taking the 930A out of the Printer mode, simply turn off the printer power.

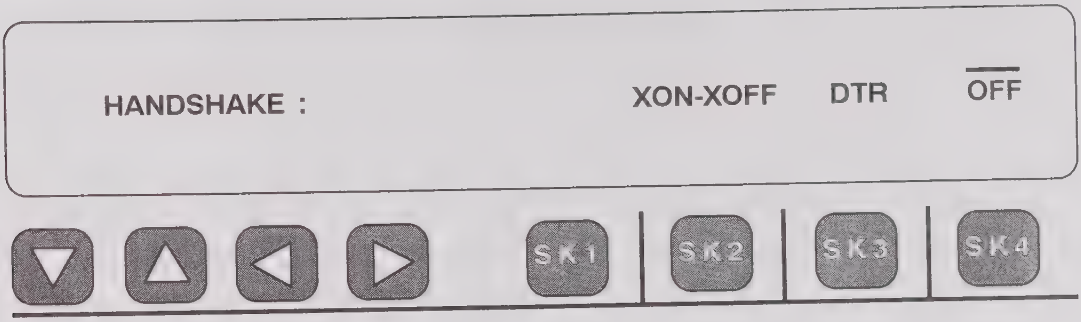
NOTE: Taking the printer **"Off-Line"** may not have the desired effect since it's buffer may fill up with unwanted material which will be printed out when the printer is placed back **"On Line"**.

5-2.2.1 PRINTER HAND SHAKE

Menu Option 89: PRINTER HANDSHAKE, allows you to select a form of flow control when the 930A sends data to the printer. This allows the printer to tell the 930A to stop sending when the printer's buffer is full or the printer is off-line. The factory default setting for the 930A is no flow control (handshake **OFF**), as it is not usually necessary.

If your printer misses characters sent by the 930A, especially during long printouts such as digit analysis or T-1 BERT history, select a lower baud rate or use Menu Option 89 to select a form of flow control.

The 930A supports **DTR** and **XON/XOFF** protocols. Press the **OPTION MENU** function key and use the **UP/DOWN** arrow keys to get to **Menu Option 89: PRINTER HANDSHAKE**. Press any softkey under the display to enter the menu. You will see a display like the one shown on the following page.


HANDSHAKE : XON-XOFF DTR OFF

The factory default is **OFF** (no handshake). This allows the 930A to send to any serial device, even if only pins 2, 3, and 7 are connected on the serial cable. If this choice is not highlighted already, you may select it by pressing Softkey 4. Cold-booting the 930A will also restore this setting.

When **DTR** handshaking is selected, the 930A will send characters to the printer only when it sees positive voltage on **DTR** (pin 20). If your printer is off line, powered down, or has a full buffer, it will not provide this voltage and the 930A will "hang" when attempting to print. This allows the printer to "catch up" by printing the contents of its buffer while the 930A waits. You will probably need to enable **DTR** handshaking on your printer by using a DIP switch. The printers supplied by SAGE are shipped with **DTR** handshaking enabled. Press Softkey 3 (under **DTR**) to enable **DTR** handshaking for the 930A.

When **XON-XOFF** handshaking is enabled, the 930A will stop sending characters to the printer when it receives the **XOFF** character (**CNTRL-S**) from the printer. It will resume sending characters when it receives the **XON** character (**CNTRL-Q**). **XON-XOFF** protocol is useful when communicating over modems or other media which do not allow a separate hardware handshake, such as the **DTR** line. Some printers support **XON-XOFF** handshaking, as do most terminals and modems. Some modems can be set to convert **DTR** handshaking to **XON-XOFF** . To set the 930A to **XON-XOFF** handshaking, press Softkey 2.

When the 930A attempts to send characters and the handshake fails (there is no voltage on DTR or an XOFF character was received without an XON), it "hangs" until either the handshake succeeds or ten seconds have passed. If ten seconds pass without a successful handshake, the 930A turns the handshake OFF and proceeds normally. If a handshake fails because a printer is turned off or left off line when the 930A needs to print, you will need to re-enable the handshake by using Menu Option 89 again. As long as the handshake is successful, the handshake protocol is stored in battery backed RAM and will remain set.

5-2.3 PRINTER APPLICATIONS

You can obtain a hard-copy printout of the 930A display line by pressing the **ENTER** key. This key rarely affects the display or operation of the 930A. The printout will contain a time and date stamp.

Currently, four types of information can be set to print out spontaneously without a key press. These are : Errors, Received Digits, Digit Analysis and Wink Timing. As more options become available this list will be expanded. **NOTE:** The results of **ROTL/Responder** tests, frequency sweep and envelope delay measurements will be printed out automatically as they occur, if the 930A is in **PRINTER** remote mode. The 930A will also print out automatically when left in the **SUPERVISION MONITOR** mode (Menu Option 8) every 4 hours, or whenever its buffer is full.

If error reporting is selected, all detected PCM errors will be time stamped and printed out as they occur. The 930A can be left to monitor a PCM channel overnight and a full error audit will be available in the morning. The list of PCM Error Messages is contained in Section 5-2.4.

If received record reporting is selected, received calls will be printed out whenever a Digit Receiver sequence is completed, or whenever the originating end abandons the call (goes **On Hook**) in mid-sequence. The number of calls, frequency of inter-LATA vs. intra-LATA calls, the number of incomplete **ANI** sequences, and abandoned calls can all be determined from the 930A's reports. All reports include a time and date stamp. If Digit Analysis has also been selected, the frequency and amplitude of each **MF** or **DTMF** tone is displayed together with the Interdigit time, and any spurious tones as well. **Dial Pulse** digits are analyzed in terms of % Break, Pulses per second and Interdigit time.

If Wink Timing reporting is selected, wink timing information will be printed out whenever a record sequence is complete, a call is abandoned, or a wink fails. The 930A times supervision events such as winks when it **SENDS** digits or when it receives digits in **MONITOR** mode. When the 930A acts as a terminating digit receiver, it provides the winks rather than timing them. Wink timing printouts can show the time between line seizure and the first wink, the length of all winks, the time between the end of a digit sequence and a wink, and the time between call completion and answer supervision. The 930A can monitor these parameters on all calls over a given PCM channel, or analog trunk, completely unattended.

5-2.4 PRINTER REPORT FORMATS

This section provides report format details and examples of 930A printouts for the various types of information.

PCM ERROR REPORTS:

Description: The label **"PCM1:,"** followed by one blank, the error detected on **PCM1** (if any), the label **"PCM2:,"** and the error detected on **PCM2** (if any). An error report is a 40 character string terminated by a line feed and carriage return. The error report will have the following form:

PCM1:	NO PCM!	**PCM2:**	NO PCM!
	FRAME LOSS		FRAME LOSS
	FRAME ERROR		FRAME ERROR
	SLIP		SLIP
	BIPOLAR VIO		BIPOLAR VIO
	REMOTE ALARM		REMOTE ALARM
	BLUE ALARM (ESF)		BLUE ALARM (ESF)
	CRC ERROR (ESF)		CRC ERROR (ESF)
	>15 ZEROS		>15 ZEROS

RECEIVED RECORD REPORTS:

A report may consist of up to four received records. Each record is a string of 40 characters terminated by a line and feed carriage return. The final record is followed by an additional carriage return and line feed. Each record takes the form:

0123456789#*ABCD REC#N HOLD DTMF

Description: There is a 17 character record field, followed by the label **"REC#"**, the record number (1-4), three blanks, the word **"HOLD"**, three blanks, and the label **"MF", "DTMF"** or **"DP"**. Dial Pulse records can be digits from 0 to 9. DTMF records can be all digits from 0 to 9 plus the characters "A", "B", "C", "D", "*", and "#". MF records may include, in addition, the characters "KP", "ST", "STP", "ST2P", and "ST3P". There are no spaces between characters and records containing less than 17 characters are preceded by blanks.

WINK TIMING REPORTS:

Wink timing reports will include all completed or interrupted supervision events from the last record sequence received. Each supervision event is sent as three strings. Each string is terminated by a line feed and carriage return. The first string takes the form:

EVENT #N

It is six characters in length and all supervision events (Winks, Off-Hooks, and Delays) are preceded by this string. The second string takes the form:

```
W 01 W 02 03 W H     NNNN    MSEC    GUARD
 (any sequence)      >16,000 MSEC
                     >60,000 MSEC
```

The record sequence is printed first and may be up to 17 characters long (shorter sequences are preceded by blanks). The length of the Guard period in milliseconds, or a time-out indicator, followed by the word **"GUARD"** is printed out next. This string is 40 characters long. The third string takes the form:

```
W 01 W 02 03 W H     NNNN    MSEC    WINK (any sequence)
                     >200    MSEC    OFF-HOOK
                     FAILED          DELAY
```

The record sequence is printed first, and may be up to 17 characters long (shorter sequences will be preceded by blanks). Next, the length of the event in milliseconds, or a time-out or failure indicator, followed by an event type label is printed out. This string is also 40 characters long. The final supervision event in the report is followed by an additional line feed and carriage return.

NOTE: If more than one type of data is included in an output, the 930A will print them out in the following order: Errors, Received Records and then Wink Timing.

5-3 OPERATION IN THE TERMINAL MODE

The Model 930A currently supports the Televideo family of terminals (the Televideo 910, 910+, 912, and 925), those terminals which can be set to emulate Televideo such as ADM, WYSE, and Hazeltine to name a few, and the VT-100 family of terminals. The former are so-called "Dumb" terminals, as distinguished from intelligent terminals, and are relatively inexpensive.

The VT-100 terminals are semi-intelligent types. The 930A supports not only the VT-100 family, but also those terminals that emulate the VT-100. Since the VT-100 is ANSI standard, any ANSI terminal can be used.

If you have a choice between Televideo and VT-100 emulation, choose Televideo. It is faster and will allow you to use your terminal cursor keys to control the 930A's UP/DOWN and LEFT/RIGHT arrow keys.

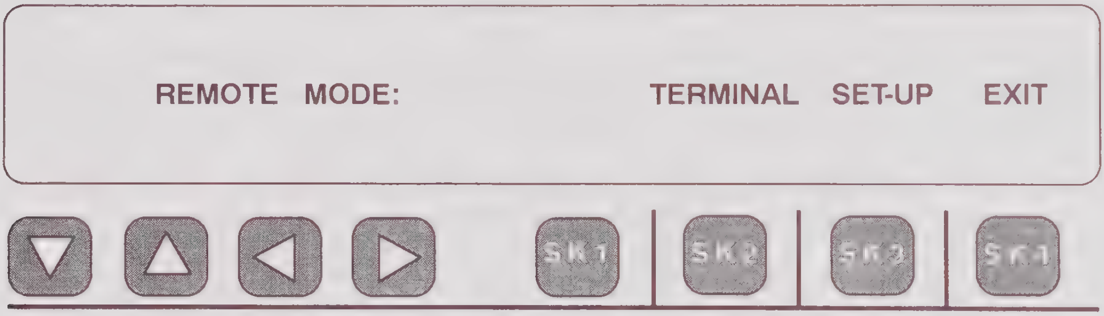
Terminal emulation programs such as CROSSTALK® and PROCOMM® allow a PC to operate the 930A in Terminal Mode. The SAGE STARMAC® Macro-language program also allows you to operate the 930A in Terminal mode.

The 930A does not currently support Teletypes or other "hard copy only" terminals such as DECwriters, except in PRINTER remote mode (Refer to Section 5-2 for details).

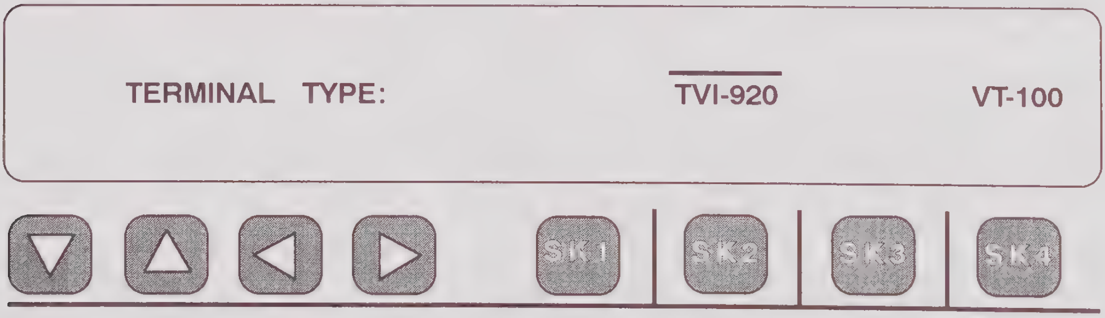
CROSSTALK and PROCOMM are registered trademarks

5-3.1 TERMINAL SET-UP

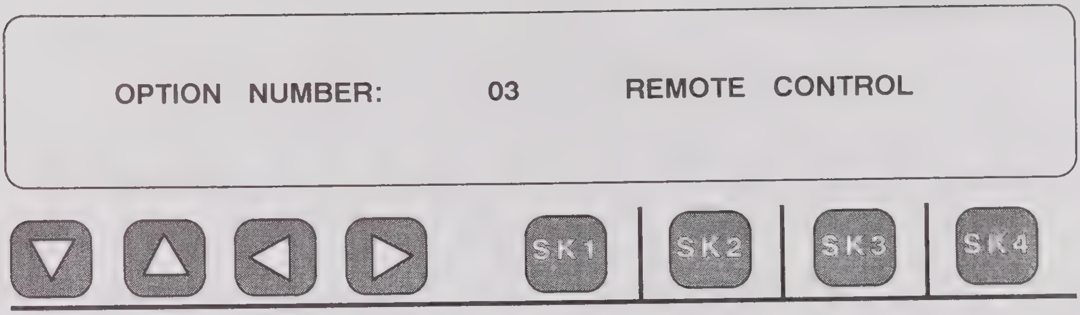
To use the Model 930A from a terminal, follow the standard set-up procedure outlined in Section 5-1.2 **SETTING THE SERIAL INTERFACE FORMAT** and Section 5-2.2 **SETTING-UP THE PRINT FUNCTION**. The procedure for setting up the data format of the 930A's serial port is identical for all remote modes. The steps are: Set the 930A Remote Mode to **OFF**, connect the terminal, set the 930A's baud rate, parity, character size, and stop bits to match the terminal's data format. Set the 930A's Remote Mode to **TERMINAL**. The 930A display will appear as shown below:



Press Softkey 4 (under **EXIT**). The 930A display will present two choices of terminal emulation as shown below:



A flashing cursor will appear over the previous Terminal emulation type used (a TVI-920 in this example). Press Softkey 2 to use Televideo 920 (or similar terminal), or Softkey 4 for DEC VT-100 terminal usage. The 930A display will immediately return to the Menu Option display as shown on the following page.



The display which should appear on the Terminal's CRT will be somewhat like that shown in Figure 5-3 below.

```
----------------------------------------------------------------------
SAGE INSTRUMENTS 930A

-----------------------------------------------------------
NORMAL LOOP   TERM   CONTACT   2W 900     o      t   (Current Trunk Type)
       [ J ]  [ K ]    [ L ]       [ ; ]   ORIG  TERM
-----------------------------------------------------------
A)  TRUNK TYPE
B)  DIAL/RING
C)  RETURN LOSS
D)  SEND TONE
E)  MEAS TONE
F)  MEAS NOISE
G)  OPTIONS

UPPERCASE  O) GO OFF HOOK     ?)  HELP    CR) ENTER     SP) CLEAR
Lowercase  o) GO ON HOOK      S)  STO      R) RCL        N) RCL NEXT

When sending digits:
To send:  0  1  2  3  4  5  6  7  8  9  -  KP  ST  STP  ST2P  ST3P  +/-
  Type:  0  1  2  3  4  5  6  7  8  9  -   *   #    a     b     c    d
----------------------------------------------------------------------
```

TERMINAL CRT DISPLAY
FIGURE 5-3

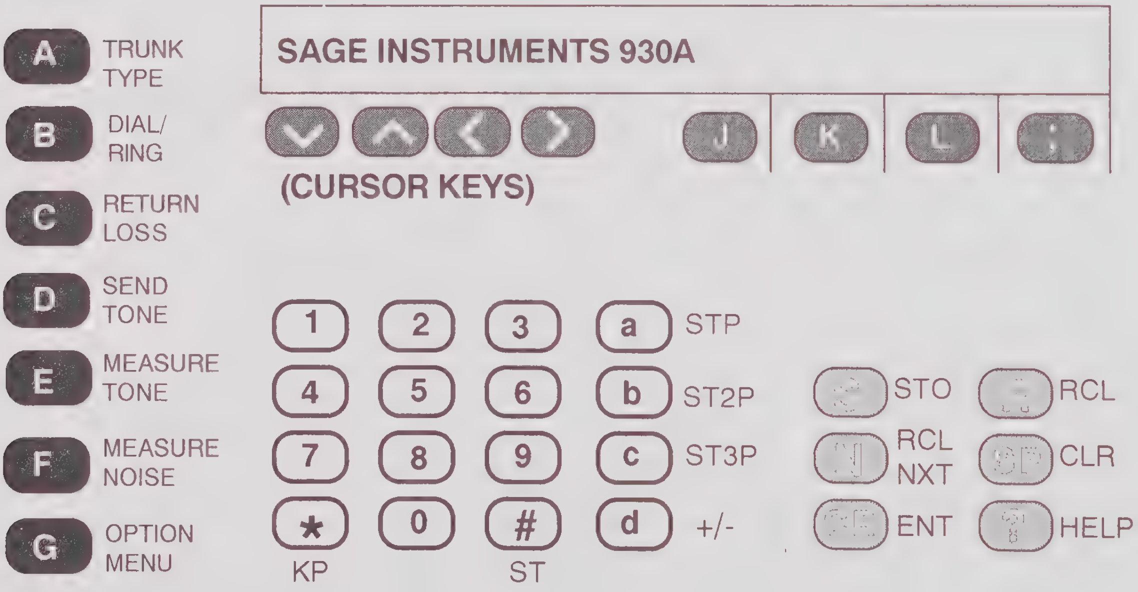
NOTE: The line marked "Current Trunk Type" will show the trunk type currently selected in the 930A.

5-3.2 TERMINAL KEYS

The commands

Each key on the 930A's front panel is mapped to a key on your PC's keyboard. Pressing a key on your PC has the effect of pressing the equivalent key on the 930A. Consequently, anything you can do with the 930A manually can also be done remotely. All legal commands are listed on the screen, and all measurements are returned immediately and updated continuously. There are no opcodes to learn. Technicians familiar with the manual operation of the 930A will learn to operate it in terminal remote mode in a day or two at most.

Front panel keys and their ASCII equivalents



Type Uppercase "O" to go Off hook, lowercase "o" to go on hook.

The **main function keys** on the 930A (the black keys along the left edge of the front panel) are mapped to the uppercase letters "A" through "G". "A" is the Trunk Type key, "B" is Dial/Ring, "C" is Return Loss, "D" is Send Tone, "E" is Measure Tone, "F" is Measure Noise and "G" is the Option Menu key.

Note: The 930A uses almost exclusively uppercase commands, so it is a good idea to enable the CAPS LOCK on your PC. To send the lowercase "a", "b", "c" or "d" with CAPS LOCK on, just press either SHIFT key along with the letter.

The **cursor keys** (the arrow keys below the 930A's display) are mapped to the cursor keys on your PC. Be sure NUM LOCK is off, or your PC "cursor keys" will act as number keys instead. You may also use Ctrl-J for down, Ctrl-K for up, Ctrl-H for left and Ctrl-L for right, and leave NUM LOCK on. If you have the enhanced AT keyboard (101 keys), you have a second set of cursor keys that are unaffected by NumLock.

The four unlabeled **soft keys** below the 930A's display are mapped to the "J", "K", "L" and ";" keys on your PC. Touch typists will recognize these as the "home" keys for the right hand. These four adjacent keys, left to right, map to the four adjacent softkeys on the 930A, also left to right, as shown in the illustration on the preceding page. These softkeys generally select or change the fields shown above them on the 930A's display.

The **numeric keypad** digits 0-9 map to the digits 0-9 on your PC's keyboard. You may use a separate keypad, use the integrated keypad and NUM LOCK, or use the digits 0-9 along the top of any PC's keyboard (If you use NUM LOCK and the integrated keypad, you will lose the use of your cursor keys while NUM LOCK is on). The KP/* key is mapped to your PC's asterisk (*) key. The ST/# key is mapped to your PC's pound (#) key. The A/STP key is mapped to lowercase "a". Similarly, the B/ST2P, C/ST3P and D/+/- keys are mapped to lowercase "b", "c" and "d".

The **special function keys** (the light gray keys in the center of the 930A front panel) are mapped as follows: "S" is for Store (STO), "R" is for Recall (RCL), "N" is for Recall Next (RCL NXT), the Space Bar is for Clear (CLR), the ENTER key is for Enter (ENT) and the Question Mark (?) is for Help (HELP).

The **hook switch** is mapped to the "O" key. Uppercase "O" tells the 930A to go Off hook. Lowercase "o" tells the 930A to go on hook. The display above the word "ORIG" on the PC's screen should echo your command, showing uppercase "O" when the 930A is Off hook and lowercase "o" when it is on hook.

5-3.3 TERMINAL CRT DISPLAY

Most of the CRT is dedicated to displaying a **HELP** screen. Only one line of the CRT changes to indicate the status of the 930A. It is set off from the others by a dotted line. It always echoes the display on the 930A front panel. In the example of Figure 5-3 the line was:

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

      NORMAL LOOP    TERM    CONTACT    2W 900     o       t

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

The **"[J] [K] [L] [;]"** below the changing display line in Figure 5-3 is meant to reflect the position of the four softkeys under the 930A front panel display. The equivalent keys on the terminal ("J", "K", "L", and ";") line up below the functions, just as Softkeys 1-4 do on the 930A. A Softkeys function is indicated by the display above it. The entire display line, using Figure 5-3 as an example, looks like:

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

  NORMAL   LOOP    TERM    CONTACT   2W 900     o      t
           [ J ]   [ K ]   [ L ]     [ ; ]     ORIG   TERM
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

A portion of the display line has the words **"ORIG"** and **"TERM"** beneath it.

These fields show the condition of the 930A's supervision lamps. The lowercase "o" and "t" in the display above indicate that both the originating and terminating ends are "On Hook". An uppercase "O" or "T" indicates an "Off Hook" condition at the originating or terminating end. A "-" in either location means "no indication", and generally signifies an incomplete or faulty circuit.

5-3.4 TROUBLESHOOTING

SYMPTOM: Terminal CRT remains blank.
PROBABLE CAUSE: Faulty or improper RS-232 cable connection.
APPROACH: Check cables, power to the terminal, and RS-232 pinouts.

SYMPTOM: Terminal prints gibberish.
PROBABLE CAUSE: Incorrect data format.
APPROACH: Turn terminal off. Set 930A Remote Mode to "OFF". Check 930A baud rate, parity, character size, and stop bits. Check terminal DIP switches to be sure of it's data format. Turn terminal on. Set the 930A remote mode to "TERMINAL" and press Softkey 4 to "EXIT".

SYMPTOM: The 930A does not respond to terminal commands.
PROBABLE CAUSE: Bad mechanical connection or CAPS LOCK not down.
APPROACH: For mechanical condition, check the cables and connectors (broken pins), power, and RS-232 pinouts. For CAPS LOCK be sure that Uppercase commands are being sent when intended. The 930A uses only a few lowercase commands so the CAPS LOCK key on the terminal should generally be down.

SYMPTOM: 930A responds to some commands but not others.
PROBABLE CAUSE: Broken lead in RS-232 cable or wrong data format.
APPROACH: For data format, refer back to the "gibberish" symptom. Be sure parity and number of bits are correct. Test the RS-232 cable with an ohmmeter or by replacing with another cable.

5-4 COMPUTER OPERATION

5-4.1 INTRODUCTION

The 930A can be operated under the control of any computer capable of sending and receiving serial ASCII characters over an RS-232 link. Each character sent to the 930A is treated as a keystroke from the 930A's front panel. A single ASCII character has been selected to represent each key on the front panel of the 930A. Sending the ASCII character is the equivalent of pressing the 930A key associated with it. For example, sending the Uppercase ASCII character "A" is the same as pressing the Trunk Type Function key. Writing a program for the 930A is just like writing a program for a programmable calculator. That is, do the operation manually and write down the key sequence. Then translate the key sequence into an ASCII string. Sending the string causes the operation to be performed. Refer to Table 5-1 for ASCII to front panel conversions as well as HEX and Decimal equivalents.

It is strongly recommended that the Terminal mode be used when writing or debugging programs intended for use in the Computer mode. Terminal mode is fully interactive and comes with on-screen **HELP**.**

There are a few ASCII characters (H, s, m, W, X, Y and Z) that will cause the 930A to perform special functions that are only performed remotely. These characters do not correspond to any keys on the 930A front panel. Refer to Table 5-2 for details.

** To operate the 930A in Terminal Mode from a PC, use a terminal emulation program such as CROSSTALK, PROCOMM, or STARMAC.

TABLE 5-1
ASCII TO FRONT PANEL KEY CONVERSION

ASCII CHARACTER	930A FUNCTION	HEX CODE	DECIMAL CODE
A	Trunk Type	41	65
B	Dial/Ring	42	66
C	Return Loss	43	67
D	Send Tone	44	68
E	Measure Tone	45	69
F	Measure Noise	46	70
G	Option Menu	47	71
RETURN	Enter	0D	13
SPACE	Clear	20	32
?	Help	3F	63
S	Store	53	83
R	Recall	52	82
N	Recall Next	4E	78
d	Change Sign (+/-)	64	100
-	Pause (Left Arrow)	2D	45
Uppercase O	Go Off Hook	4F	79
Lowercase o	Go On Hook	6F	111
J	Softkey 1	4A	74
K	Softkey 2	4B	75
L	Softkey 3	4C	76
;	Softkey 4	3B	59
^H (Left Cursor)	Left Arrow	08	8
^L (Right Cursor)	Right Arrow	0C	12
^K (Up Cursor)	Up Arrow	0B	11
^J (Down Cursor)	Down Arrow	0A	10

TO SEND	TYPE	HEX	DEC	TO SEND	TYPE	HEX	DEC
0	0	30	48	*	*	2A	42
1	1	31	49	#	#	23	35
2	2	32	50	A	a	61	97
3	3	33	51	B	b	62	98
4	4	34	52	C	c	63	99
5	5	35	53	D	d	64	100
6	6	36	54	KP	*	2A	42
7	7	37	55	ST	#	23	35
8	8	38	56	STP	a	61	97
9	9	39	57	ST2P	b	62	98
				ST3P	c	63	99

TABLE 5-2
SPECIAL ASCII CHARACTERS FOR REMOTE CONTROL

CHARACTER	FUNCTION	HEX	DEC
H	Causes the 930A to send a copy of it's terminal HELP screen (See Figure 5-3) to the remote computer or terminal.	48	72
m	Causes 930A to send "Hang-Up" string to a Hayes compatible MODEM.	6D	109
s	Places 930A in "Standby Mode".	73	115
W	Causes the 930A to report all pending PCM errors, received records, wink timing information or 105 test results to the host computer. Information is "pending" when an ALERT has been sent but no REPORT has been requested.	57	87
X	Interrupts the 930A and causes it to send an immediate copy of it's current display line to the host computer. This command is not buffered and executed in turn. It is executed at once.	58	88
Y	Causes the 930A to send a copy of it's current display line to the host computer. This command is buffered and executes after all previous commands have been completed.	59	89
Z	Causes the 930A to send a copy of it's current display line after it determines that a valid measurement has been made. A series of consecutive "Z" commands will cause the 930A to send consecutive measurements to the host computer.	5A	90

NOTES: The "X", "Y", and "Z" commands all cause the 930A to send a copy of it's display line to the host computer.

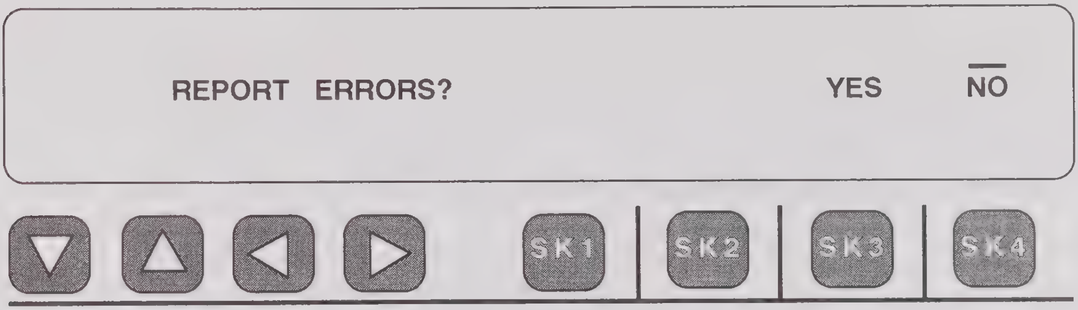
The "X" command executes immediately and can be used to find the current status of the 930A. This allows "spot checking" progress through a command sequence at any time.

The "Y" command tells the 930A to send a copy of it's display line when it reaches a certain point in the command sequence. This can be used to obtain a measurement or start a timer in the host.

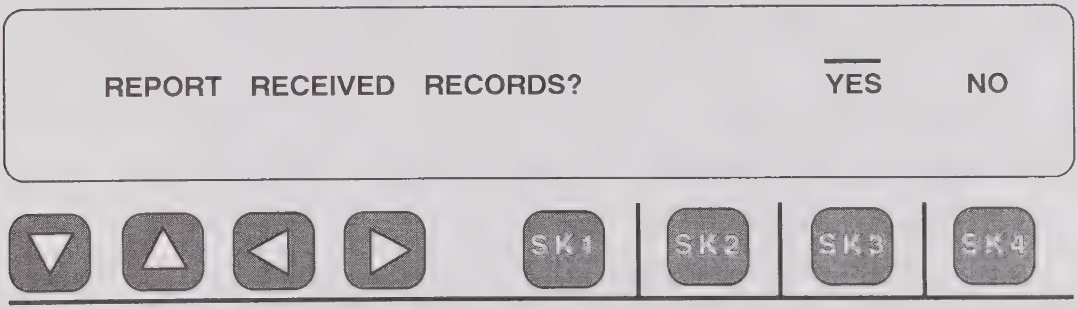
The "Z" command is like the "Y" command, except that successive "Z" commands will each be delayed by one measurement period.

5-4.2 SETTING-UP THE COMPUTER MODE

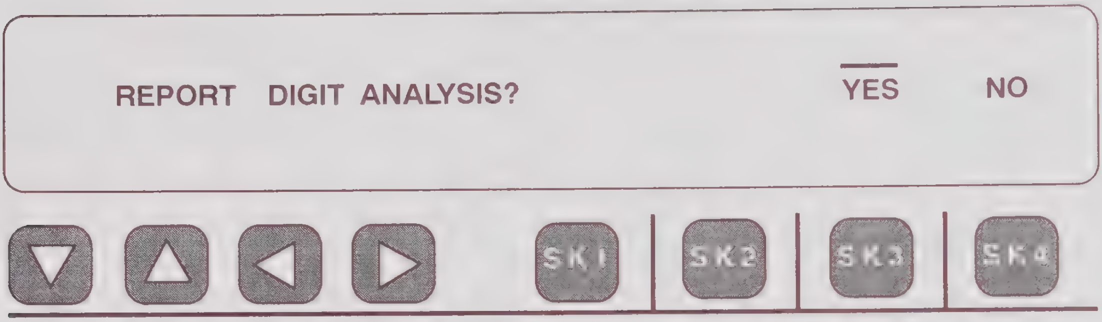
The set-up procedure for the Computer Mode of the 930A is the same as outlined in Sections 5-1.2 and 5-2.2. To review: set the 930A's Remote Mode to **OFF**. Connect the computer to the 930A serial port. Use the **SET-UP** menu to set the 930A's baud rate, parity, character size, and stop bits. Set the Remote Mode to **COMPUTER** and press **EXIT**. The 930A will ask the following questions:



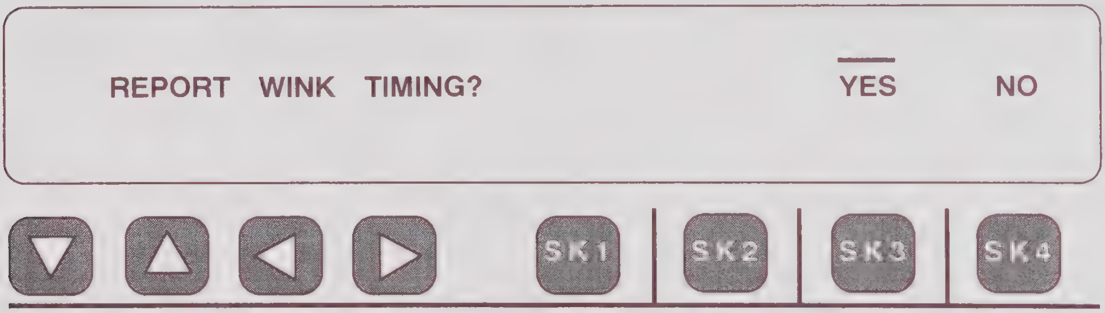
Press Softkey 3 (under **YES**) to have the 930A alert the host computer when it detects PCM errors. Press Softkey 4 if no alert for PCM errors is required. The display will advance to the next question:



Press Softkey 3 (under **YES**) to have the 930A alert the host computer upon completion, or interruption, of a Digit Receiver sequence. Otherwise, press Softkey 4. If you answer **YES** the 930A display automatically advances to the next question.

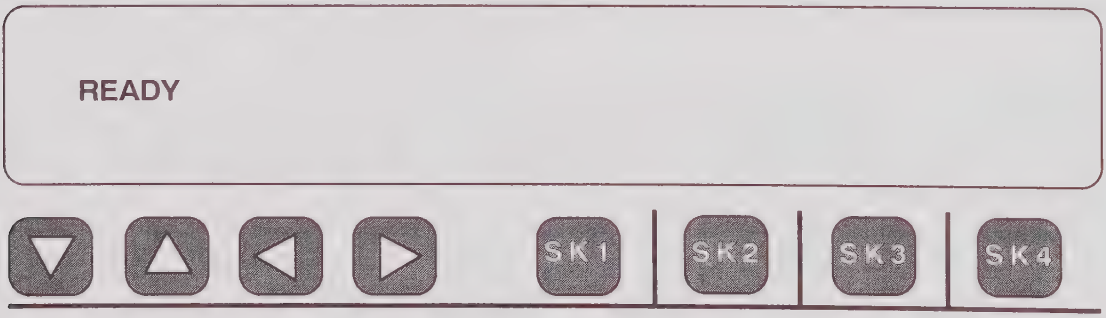


Press Softkey 3 (under **YES**) to have the 930A append an analysis of the received digit amplitudes, frequencies, On and Off times, % Break, Rate and Interdigit Time to the report on received digits. Press Softkey 4 if the analysis is not wanted. This screen does not appear if you answered **NO** to the question: "**REPORT RECEIVED RECORDS?**".



Press Softkey 3 (under **YES**) if the 930A is to alert the host computer when it has Wink Timing information available. Otherwise, press Softkey 4.

The 930A display should then read:



A prompt will be sent to the host computer to indicate that the 930A's command buffer is empty and the 930A is awaiting instructions.

5-4.3 INPUT TO THE 930A

Input to the 930A is in the form of "command strings". These are strings of ASCII characters that the 930A recognizes as commands. A command string may be from 1 to 40 characters in length. The 930A has a 40 character input buffer. Tables 5-1 and 5-2 contain summaries of these commands and Section 5-3.2 describes them.

The 930A will echo each character back to the computer as it is received and placed in the buffer. **DO NOT SEND THE NEXT CHARACTER UNTIL THE ECHO HAS BEEN RECEIVED.** This is the 930A input protocol (actually a handshake). The 930A executes the commands in the order they are received, with the exception of the **"X"** character, which executes immediately. When all received commands have been executed, and the input buffer is empty, the 930A will signal the host computer with a “**>**” prompt.

The 930A will echo and ignore any characters it does not recognize as commands. No error message is sent back.

5-4.4 OUTPUT FROM THE 930A

Output from the 930A consists of the following:

ECHOES - - - The 930A echoes all received characters to the host computer.

PROMPTS - When the 930A has executed all received commands, and its command buffer is empty, it sends a prompt consisting of a line feed, carriage return, and a **">"** character. The ASCII sequence in Hexadecimal code is 0A 0D 3E. Some data strings include the **">"** character, but the 0D 3E sequence is unique.

ALERTS - - Under certain circumstances, the 930A will send a "bell" character (ASCII 07) to alert the host computer that it has something to report. Any programs the user writes should screen all 930A output carefully for this character. If the Beep on Error feature (Menu Option 15) is turned **"OFF"**, no bell character will be sent.

DATA - - - - When the 930A executes an X, Y, or Z command, it sends a copy of it's current display line and supervision status. This is a 50 character line terminated by a line feed and carriage return. Section 5-4.5 contains details of display line formats.

REPORTS - If the 930A has sent the host computer an **ALERT**, it will respond to the **"W"** command with a report concerning what caused the **ALERT**. This could be a PCM error, a completed Receive Record sequence, Wink Timing information, 105 test results or some combination of the four. Section 5-2.4 contains further details of Report Formats. When used as a Near End Responder (Menu Option 26), the 930A will send an alert (Bell) at the completion of each test.

5-4.5 DISPLAY LINE FORMATS

A Display Line is always 50 characters long, terminated by a carriage return and line feed. The first 40 characters of a Display Line mirror the display on the front panel of the 930A. The next 4 characters are ASCII blanks. The forty-fifth character shows originating supervision. The next 4 characters are ASCII blanks. The fiftieth character shows terminating end supervision. Typical example displays of the computer's CRT are provided.

TYPICAL CRT DISPLAYS:

MEASURE TONE:

```
NNNN Hz    +NN.N  dBm0   AVERAGE    PCM1    O     T
- - - -    OVER   dBm    RMS        PCM2    o     t
           - - - -  dB              T1R1    -     -
           - - - -  dB              TR      -     -
```

Description -- Seven leading blanks, followed by the frequency in Hertz or four dashes, the label **"Hz "**, a signed level or the over or under indication (**"OVER"** or "----"), the relative zero label, the **"AVERAGE"** or **"RMS"** label, and the signal source label.

MEASURE NOISE:

```
+NNN  dBrn0   C-NOTCH   PCM1    CHANNEL   O    T
      dBrn    3K FLT    PCM2    N-TO-G    o    t
      dB      C-MSG     T1R1    BAL       -    -
      dB      S/N       TR
```

Description --- Three leading blanks, followed by a signed level measurement, the relative zero label, the filter type, the signal source label, and the type of measurement.

RETURN LOSS:

4-WIRE:

```
+NNNdB     SRL  LO NNNNHz   +NN  THL   4W  1200    O     T
           SRL  HI                     4W   900    o     t
           ERL                         4W   600    -     -
           OSC                         PCM1
                                       PCM2
```

Description --- Two leading blanks, followed by a signed level measurement and the label "dB", the signal type, the frequency of the echo suppress tone or the oscillator tone and the label **"Hz"**, a signed trans-hybrid loss level and the label **"THL"**, and a trunk type label.

2-WIRE: -- NORMAL:

```
+NNNdB     SRL  LO  NNNNHz       2W  1200          O     T
           SRL  HI               2W  900           o     t
           ERL                   2W  600           -     -
           OSC                   2W  150
```

Description --- Two leading blanks, followed by a signed level measurement and the label **"dB "**, the signal type, the frequency of the echo suppress tone or oscillator tone and the label **"Hz"**, ten blanks, and a trunk type label.

2-WIRE: -- TR TERM:

```
     TR  TERM      AC  SHORT  2W     O      T
                   AC  OPEN          o      t
                   900+2.16          -      -
                   600+2.16
```

Description --- 9 leading blanks, followed by the label **"TR TERM"** and an additional 8 blanks, a circuit descriptor label, and the **"2W"** descriptor with 9 trailing blanks.

In the previous examples of typical CRT displays, numbers were denoted by a single "N" for each possible digit. The understanding was that this "N" was showing location, rather than numerical value. In fact, each "N" could stand for any number. If a decimal point were present, it was shown as a "." . Signed numbers were shown being preceded by a "+" character. In practice, this could be either a "+" or "-".

Leading zeros will be printed as blanks and trailing zeros will be printed as zeros. The digit to the left of the decimal point will always be printed, even if it is a leading zero. The sign of the number will always be printed to the left of the first non-blank digit.

For example, a number which was represented by "+NN.N" could be any of the following in practice:

+99.9, -1.0, +0.0, -0.4, +7.4

5-4.6 PROGRAMMERS NOTES

5-4.6.1 INITIALIZING THE 930A

Send the command string **"AAA"** when you first access the 930A remotely. This ensures that you have exited from any tests or sub-menus the 930A may have been left in. You may use any of the Function key commands (A,B,C,D,E,F or G), but three repetitions is the minimum necessary to bring the 930A to a known state before testing. By sending **"AAA"** you take the 930A to the Trunk Type menu, no matter where it was previously. Sending **"GGG"** would take the 930A to the Option Menu instead.

After this initial string has been sent, you should probably send a Trunk Type initialization string, to ensure that the 930A is properly terminated or bridged, looking at the correct signaling leads, etc. Use the **HELP** menu in Trunk Type to accomplish this (see the following pages for details). Two examples would be:

NORMAL LOOP TERM CONTACT 2W 900: "A?J;;LKK"
E&M TYPE II TERM SEND-E 4W 600: "A?L2JK;K;"

It is a good idea to append a lowercase "o" to your initialization string, to ensure that the 930A is On-Hook.

To ensure that the 930A is in quiet termination (sending no tone), you should send a Send Tone initialization string, such as "D?;1004J160J." This sets the frequency to 1004 Hz, the level to -16.0 dBm, and the output to **OFF**.

Note: in the example above, the numeric input for frequency and level were terminated by the **"J"** character. Numeric input may be terminated by a carriage return or any softkey (J, K, L or ;). Since the carriage return is difficult to display, the **"J"** character has been used in all the examples contained in this document.

You may now use the 930A to send or receive calls, send and measure tones and other VF signals, and perform automated tests to remote test lines and responders. The following section on **HELP** menus will get you started. There are separate sections on placing multistage calls, using the digit receiver/analyzer, and placing calls to remote test lines and responders.

If the 930As available to you do not all have the same software revision, or have different options installed, the tests available or the method of performing such tests may vary. Sage Instruments will upgrade your company's instruments to the current software revision at no charge. It will make your task simpler if your company orders all 930As with the same set of options. If this is not possible, make use of Menu Options 91 (**Software Version**) and 94 (**List Options**) to determine the software revision and installed options.

For the convenience of programmers the 930A can be commanded remotely to dump its buffers and restore itself to the factory defaults. This allows the programmer to write software starting at a known configuration every time. Menu Option 92: SOFTWARE COLD-BOOT is used for this purpose. Simply begin the program by getting to the Option Menu function, enter the number 92, send a Return and then send a ‘K’. The sequence looks like:

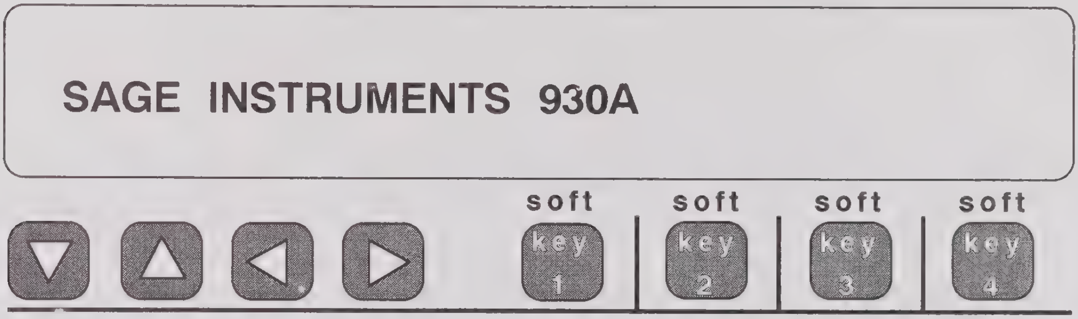
“ **GGG92|K**”

This command does not affect the RS-232 remote port settings nor does it affect the time/date settings. **NOTE:** A hardware cold-boot (described in Section 3-2.2) will restore the RS-232 port settings to their factory default values.

5-4.6.2 USING THE HELP MENUS

Pressing the **HELP** key on the 930A brings up a series of menus for the user. The menu presented will depend on the function the 930A is executing. Transmitting the ASCII **"?"** character remotely has the same effect as pressing the **HELP** key.

Many of the 930A's features are controlled using softkeys (the four unlabeled keys directly beneath the display).



These softkeys often take the place of thumbwheels or on/off toggles. The current setting is usually displayed above the softkey (for example, in **MEASURE NOISE**, the display over Softkey 2 shows either **"C-NOTCH", "C-MSG", "3K FLAT", or "S/N"**). If the display shows what you want, you do nothing: the setting is already correct. Otherwise, press the softkey until the display shows the setting you want.

This is fairly simple for you or I, but for a computer it presents problems. Just "looking" to see that the display shows the desired setting is a nuisance. Going into a loop that presses the softkey, looks at the display, and repeats until it's correct is a major annoyance.

Using the **HELP** menus allows the computer to avoid this procedure. When it wants the C-Notch filter, the computer sends a short character string that always selects C-Notch, regardless of the previous state.

Once you have used a **HELP** menu to put the 930A in a known state, it may be more efficient to use the softkeys in the usual way. You would always use the **HELP** menus when your program begins: this provides a simple and foolproof initialization. After using a **HELP** menu once to put the 930A in a known state, you may continue to use the **HELP** menus throughout your program or pursue greater efficiency by using the softkeys. The difference is typically only a few extra characters and a few hundred milliseconds, and the choice is really a matter of programming style.

The following section gives a brief overview of the **HELP** menus and includes some sample command strings.

TRUNK TYPE (Analog circuits)

Trunk Type Help Type/Sense Direction Bridge/Term
Ohms 2W/4W

Trunk Type	A =Trunk Type		
Help	? =Help		
Type	J =Loop	K = Ground-Start	L{1-5}J = E&M Type I-5
Sense*	K = Normal	; = Reverse	
Direction	K =Battery	; = Contact	K =SEND-E ; = SEND-M
Bridge/Term	K =Bridge	; = Terminate	
Ohms	J =150Ω	K = 600Ω	L = 900Ω ; = 1200Ω
2W/4W	K =2 Wire	; = 4 Wire	

* (Loop and Gnd-Start only)

Examples:

E&M Type I	TERM SEND-E 4W 600	**"A?L1JK;K;"**
E&M Type II	TERM SEND-M 2W 900	**"A?L2J;;LK"**
LOOP NORMAL	TERM CONTACT 2W 900	**"A?JK;;LK"**

Toggle Bridge/Term	**"K"**
Toggle Direction	**"L"**

DIAL/RING

Dial/Ring Help Pulsing Digits

Dial/Ring	B =Dial/Ring
Help	? =Help
Pulsing	K =Dial Pulse L = MF ; = DTMF
Digits	Up to 17 digits All pulsing types: 0-9, "-" for 1 sec. pause DTMF: a,b,c,d,*,# MF: *=KP, #=ST, a=STP, b=ST2P, c=ST3P

If you are already Off-Hook, the digits will be sent immediately. If you are On-Hook, the digits will be stored in **DIAL/RING**. Go off hook and send ASCII **"K"** to send stored digits.

Sending an ASCII blank " " clears any existing digits. Using the **HELP** key also clears any previous digits.

Examples:

Go to **DIAL/RING**. Go off hook. Select DTMF. Dial (408) 761-1000:
"BO?;4087611000"

Go to **DIAL/RING**. Go on hook. Select MF. Store KP007ST to be dialed later:
"Bo?L*007#"

Go to **DIAL/RING**. Go off hook. Select Dial Pulse. Pause 1 second and dial 9:
"BO?K-9"

Go to **DIAL/RING**. Go off hook and send the most recently entered digit string:
"BOK"

Go to **DIAL/RING**, clear any old digits, and dial "411" in the current pulse mode:
"B 411"

RETURN LOSS

4 Wire:

Return Loss Help Band Frequency Acknowledge Set THL

Return Loss	C =Return Loss
Help? =	Help
Band	J =SRL-LO K = SRL-HI L = ERL ; = OSC (sine wave)
Frequency	nnnnJ = freq. of nnnn Hz for echo suppress tone and/or sine wave Return Loss
Acknowledge	J,K,L or ; acknowledges message
Set THL	L = Current measurement is THL ;nnJ = THL is -nn dB

2 Wire:

Return Loss Help Mode [Band Frequency] or [Termination]

Return Loss	C =Return Loss
Help? =	Help
Mode	K =Return Loss ; = TR Termination

Return Loss:

Band	J =SRL-LO K = SRL-HI L = ERL ; = OSC (sine wave)
Frequency	nnnnJ = freq. of nnnn Hz for echo suppress tone and/or sine wave

TR Termination:

Termination: J=AC Short K=600Ω+2.14μF L=900Ω+2.14μF ;=AC Open

Examples:

4W:

Go to Return Loss. Select ERL, 2225 Hz Echo Suppress, no THL compensation:

"C?L2225JJ0J"

Go to Return Loss. Select SRL-LO, 2225 Hz Echo Suppress, measure **THL**:

"C?J2225JJK"

2W:

Go to Return Loss. Select SRL-LO, 2225 Hz Echo Suppress tone:

"C?KJ2225J"

Go to Return Loss. Select 900Ω with 2.14μF quiet termination:

"C?;L"

All types:

Send echo suppress tone: **"K"**

SEND TONE

Send Tone Help Output Frequency Level

Send Tone	D =Send Tone
Help	? =Help
Output	K =ON ; = OFF
Frequency	nnnnJ = frequency of nnnn Hz
Level	nnnJ = level of -nn.n dBm (for level of +nn.n dBm, send "nnndJ")

Examples:

Send 1004 Hz at 0.0 dBm	**"D?K1004J0J"**
Send 1004 Hz at -16.0 dBm	**"D?K1004J160J"**
Send 2804 Hz at -13.0 dBm	**"D?K2804J130J"**
Send 404 Hz at +3.2 dBm	**"D?K0404J32dJ"**
Set freq. and level to 104 Hz at -10.0 dBm: do not send tone:	**"D?;0104J100J"**
Toggle tone on/off	**"D;"**
Set freq. to 1010 Hz	**"DJ1010J"**
Set level to -16.0 dBm	**"DK160J"**

MEASURE TONE

Measure Tone **Help** **Reference** **Mode***

Measure Tone	E = Measure Tone	
Help	? = Help	
Reference	K = Absolute (dBm)	L = Set 0 (dB relative to current level)
	;nnnJ = dBm0 (dB relative to -nn.n dBm)	
Mode*	K = Average[1]	; = RMS[2]

* Software Rev. 3.17 and later

[1] Use **Average** to measure sine waves

[2] Use **RMS** to measure the level of non-sinewave tones and digital milliwatt

Examples:

Measure in dBm: **"E?KK"**

Make future measurements in dB relative to -16.0 dBm: **"E?;160JK"**

Make future measurements in dB relative to current measured level: **"E?LK"**

Make RMS measurements in dBm: **"E?K;"**

Toggle RMS/Average: **"L"**

Measure tone: **"E" "Z"** (Wait 1 sec. between sending "E" and "Z")
or **"EZZ"** (Disregard first measurement)

Note: If a tone has been selected in **SEND TONE**, and the output is **ON**, the tone will also be sent in **MEASURE TONE**. To measure far-to-near tone on a 2-Wire circuit, be sure **SEND TONE**'s output is set to **"OFF"**.

MEASURE NOISE

Measure Noise **Help** **Filter** **Mode*** **Reference**

Measure Noise	F = Measure Noise
Help	? = Help
Filter	J = 3 KHz flat K = C-Message L = C-Notch ; = Signal/Noise
Mode* †	K = Balanced ; = Noise-to-ground
Reference †	K = Absolute (dBrn) L = Set 0 (dB relative to current level) ;nnndJ = dBrn0 (dB relative to nnn dBrn)

* Not available in PCM. In PCM, the 930A measures channel noise only.

† Not available when making signal/noise measurement.

Examples:

Measure balanced noise in dBrnC using the C-Notch filter: **"F?LKK"**

Measure signal/noise: **"F?;"**

Measure noise-to-ground relative to 90 dBrn using the 3 KHz flat filter:
"F?J;090dJ"

Measure noise: **"F"** **"Z"** (Wait 1 sec. between sending "F" and "Z")
or **"FZZ"** (Disregard first measurement)

Note: If a tone has been selected in **SEND TONE**, and the output is **ON**, the tone will also be sent in **MEASURE NOISE**. To measure far-to-near noise on a 2-wire circuit, be sure **SEND TONE**'s output is set to **"OFF"**.

5-4.6.3 WHEN DOES THE 930A SEND A BELL?

The 930A can be set to wait for or detect a variety of events. The 930A sends the bell character to let the remote operator or computer program know that such an event has occured. Some events are reported only if the user selects them. Others are reported only if the 930A is performing a certain function. You can select the events which will be reported from Menu Option 34 SELECT REPORTS. This allows reporting to be turned ON or OFF for PCM Errors, Received Calls, or Wink Timing. The bell is sent **only** in Computer Remote mode. The following lists the events and conditions for a bell to be sent.

EVENT	REPORTED WHEN 930A IN:
PCM ERROR--An error on the T1 span such as a slip, bipolar violation, remote alarm, etc. has been detected.	**PCM** Trunk Type. **REPORT PCM ERRORS** selected.
INCOMING CALL COMPLETE--The 930A has received a call.	Option Menu 4: Digit Receiver **REPORT RECEIVED RECORDS** selected.
WINK TIMING AVAILABLE--A call has completed or abandoned, and a wink, off-hook, delay dial event, dial-tone or credit card “bong” was expected.	Option Menu 2: Send Digit Sequences Option Menu 4: Digit Receiver **REPORT WINK TIMING** selected.
WINK FAILURE--An expected wink, off-hook, delay dial event, dialtone or “bong” failed to appear or was not recognizable.	Option Menu 2: Send Digit Sequences Option Menu 4: Digit Receiver
SIGNALING BIT CHANGE--An A, B, C, or D bit has changed state on one of the 24 PCM Channels.	**PCM** Trunk Type Option Menu 20: 24 Bit Display
RINGING OR LINE SEIZURE--The 930A detects ringing or seizure and goes off-hook.	Option Menu 32: Dial-Up Testline Option Menu 33: Dial-Up Sweep

EVENT	REPORTED WHEN 930A IN:
IMPULSE or HIT--An Impulse, gain hit, phase hit or dropout has occured.	Option Menu 11: Impulse and Hits
CALL PROGRESS FAILURE--The 930A detects Busy, Reorder, Dead Line or any other call progress failure when it attempts to access a test line.	Calling to a test line from: Option Menu 2: Send Digit Sequences Option Menu 26: ROTL/Responder Option Menu 27: ROTL Interrogator Option Menu 28: Transponder Test Option Menu 29: Call 102 Line
TEST DATA AVAILABLE--A test to a far end test line has completed, or has a screen full of results available. LOSS has one screen of data (one bell), GAIN SLOPE has three screens of data (one bell each), etc.	Calling to a test line from: Option Menu 2: Send Digit Sequences Option Menu 26: ROTL/Responder Option Menu 27: ROTL Interrogator Option Menu 28: Transponder Test Option Menu 29: Call 102 Line

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SECTION VI
T-CARRIER MEASUREMENTS

6-1 THE T-1 PCM TRUNK TYPE INTERFACE (OPTION 930A-08E OR -09E)

This section of the manual describes the operation of the 930A when Option 930A-08E (**Single Direction PCM**) or Option 930A-09E (**Dual Direction Drop and Insert**) has been installed in the 930A. **NOTE:** If Option 930A-17 (No analog interface) has been ordered, there are no other Trunk Type selections available **except PCM**.

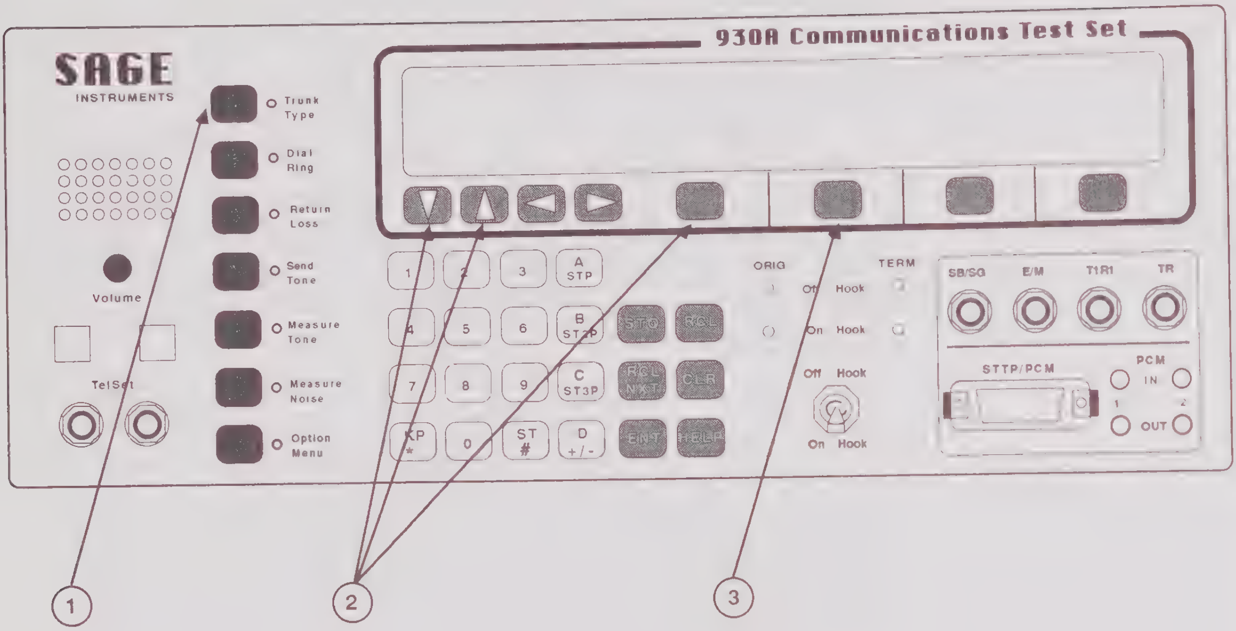
Either Option 930A-08E, or -09E, has the capability to operate on the normal **D4 Superframe** format T-1 carrier, as well as the **SLC-96** system and the new Extended Superframe (**ESF**) format. The 930A will detect whether the T-Carrier is a **D4 Superframe** or **ESF** formatted signal, and set itself automatically when first plugged into the span at the **DSX**. **It does not** set itself for **SLC-96**, so you will have to select **SLC-96** framing **manually** to work on a **SLC-96** span. **Once you have selected SLC-96 framing**, the 930A operates exactly the same as it does on any other T-1. The examples which follow are useful in any framing format.

The 930A comes from the factory with the most commonly used settings as its defaults so it is not normally necessary for you to change anything in the set-up menu. All you have to do is turn it on and plug it into the **DSX** jacks to begin testing.

The factory DS-1 (T-1) defaults are:

Impedance:	**100 ohms**
Framing:	**D4 Superframe**
Signaling:	**Robbed-Bit**
Line Coding:	**Alternate Mark Inversion**
Channel Numbering Sequence:	**D3/D4**
Supervision:	**Normal (E&M)**

When you first turn on the 930A it could be in any Trunk Type because it remembers the last trunk it was set to when it was turned off. **The first thing** you do, after you turn on the 930A, is **select the PCM Trunk Type**.



To select **T-1 (DS-1) PCM** Trunk Type:

1. Press the **TRUNK TYPE** function key.
2. Use the **UP/DOWN** arrow keys or Softkey 1 to select the display entitled "**OPTIONAL TYPES**".
3. Press Softkey 2 (under **PCM**).
4. Refer to Section 6-6.1 for operating details in **PCM**.

PCM TRUNK TYPE SELECTION
FIGURE 6-1

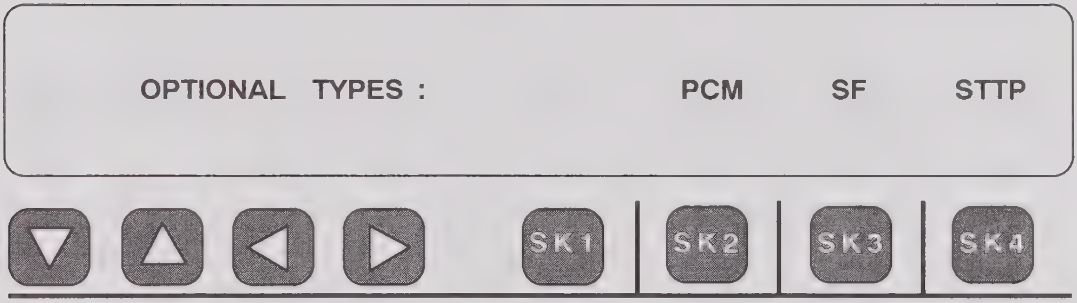
To select the PCM Trunk Type, press the following keys on the 930A:

Press the Trunk Type function key

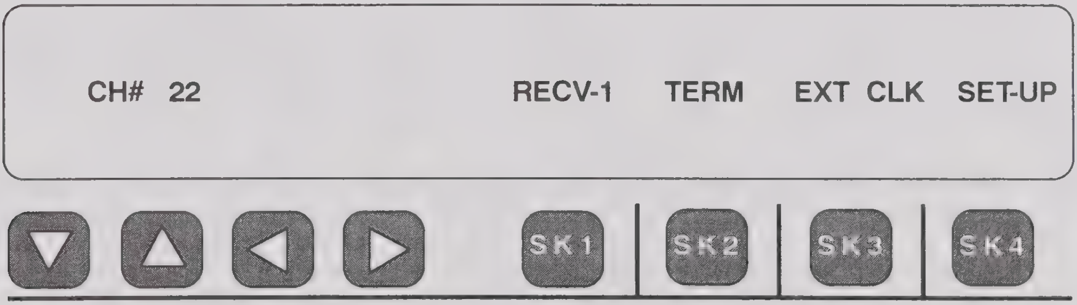
to display the currently selected Trunk Type.

Use the UP/DOWN arrow keys to

page through the available displays until you see the following display appear:



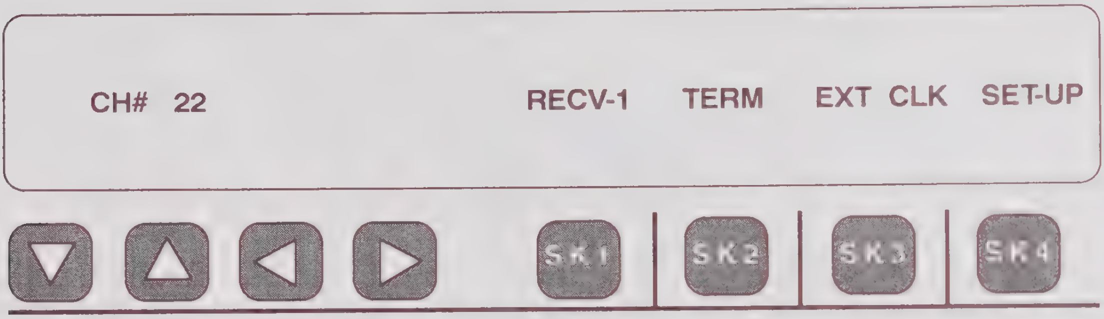
Press Softkey 2 (under **PCM**) and the 930A will show you the **PCM** Trunk Type display. This display returns to the last settings you had entered. The display below shows the factory default **PCM** display.



At this point, you must know how your own network is configured, what you want to test for, where and how to connect the 930A to access your T-1 span. The sections which follow give you examples of some common tests you can perform with the 930A and how to connect the 930A to a standard **DSX** test access jack field.

6-1.1 HOW TO CHANGE PCM CHANNELS AND TEST DIRECTION

Start from the main PCM default display. An example is shown below:

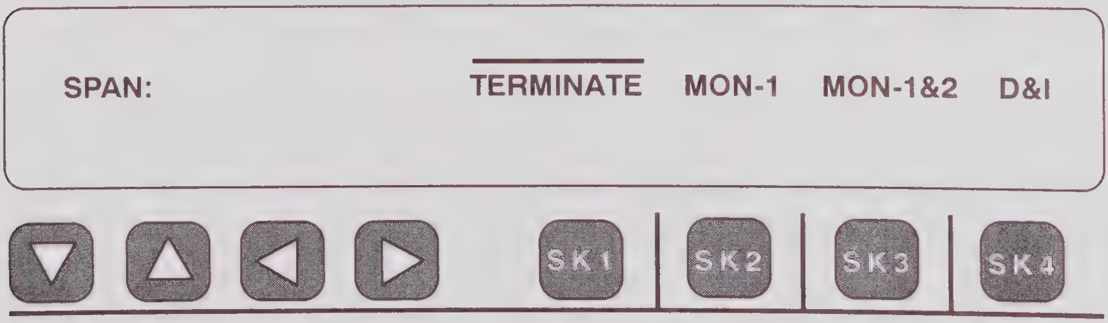


TO CHANGE PCM CHANNELS, use the **UP/DOWN** Arrow keys just as you do with a TV remote control, or enter the number of the channel (1 to 24) from the Numeric keypad, and press the **ENTER** key.

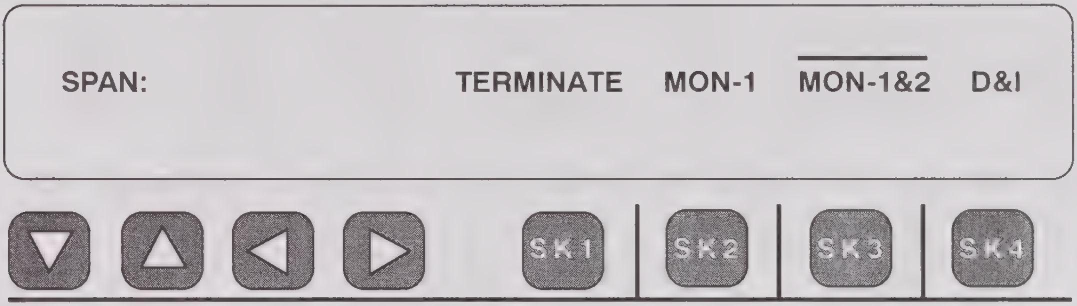
TO SELECT TEST DIRECTION, press Softkey 1 (under **RECV-1**). This key is only active if you are in the **MON-1&2** or **D&I** mode. It toggles between side 1 and side 2, and vice versa, without having to swap test cords around. If you are in **TERMINATE** or **MON-1**, the key is inactive because only side 1 is receiving.

Option 930A-08E gives you only **TERMINATE** and **MON-1** modes. To have the capability of looking in both directions, you must have **Option 930A-09E** in your 930A. **Option 930A-09E** gives you the additional **MON-1&2** and **D&I** modes. It has two transmitters and two receivers.

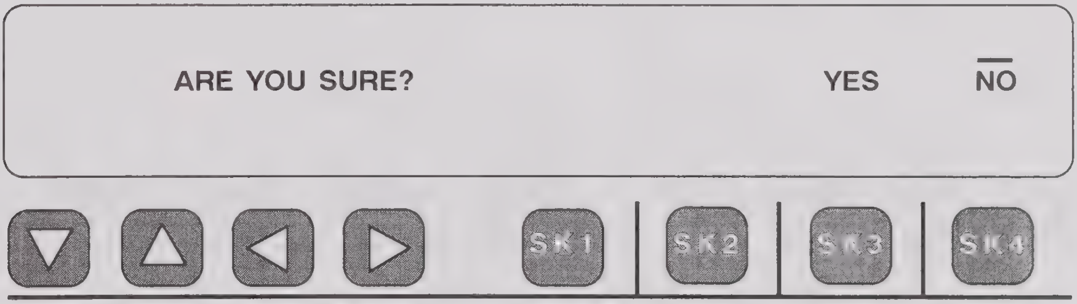
TO SELECT THE SPAN TEST MODE, press Softkey 2 (under **TERM** in the default display above). This brings up your other choices. Press the softkey directly under the mode you want in the display shown below.



In **TERMINATE** mode, the 930A acts as a channel bank terminating one end of the span. **MON-1** is used for monitoring one direction of transmission while **MON-1&2** is used to monitor traffic in both directions simultaneously by activating both of the 930A's receivers. The **D&I**, or Drop and Insert, mode is used on live spans between two switches or multiplexers, etc. One of the 24 channels is dropped out for testing while the other 23 pass through undisturbed.

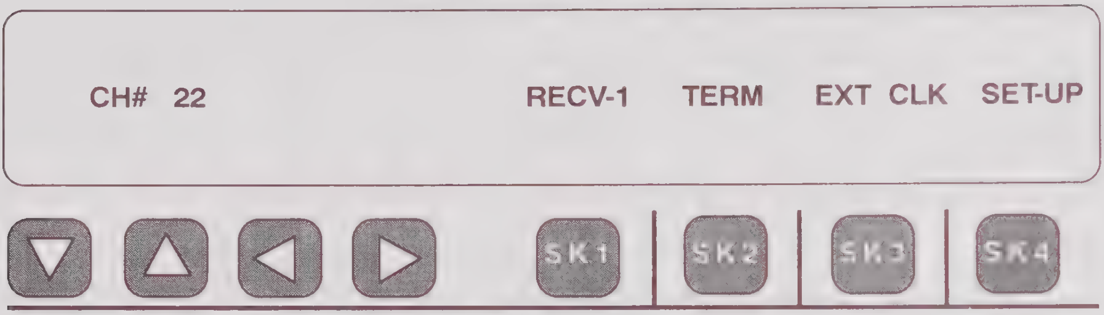

SPAN: TERMINATE MON-1 MON-1&2 D&I

If the 930A is in either **MON-1&2** or **D&I** mode, and you select **TERMINATE** or **MON-1** mode, you will be prompted with the screen:


ARE YOU SURE? YES NO

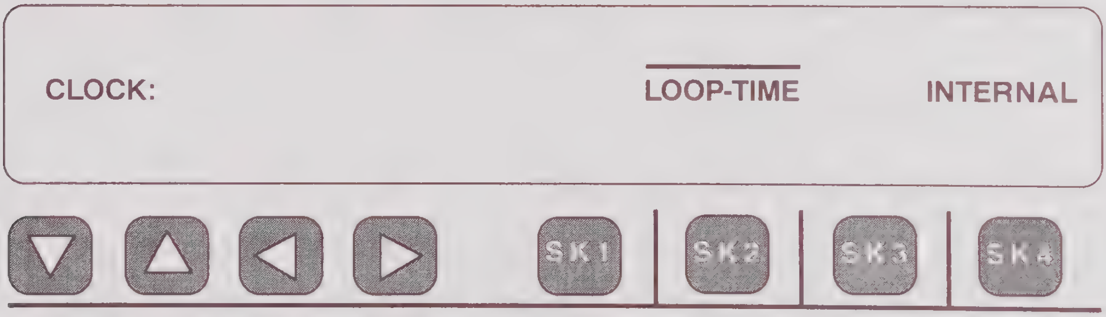
This prevents you from accidentally dropping a live span by choosing **TERMINATE** or **MON-1**. It does not prevent you from doing so intentionally. After you choose a test mode, the 930A will return to the main menu and show the change.

To Terminate the span, press Softkey 1 (under **TERMINATE**). The 930A display would change to:

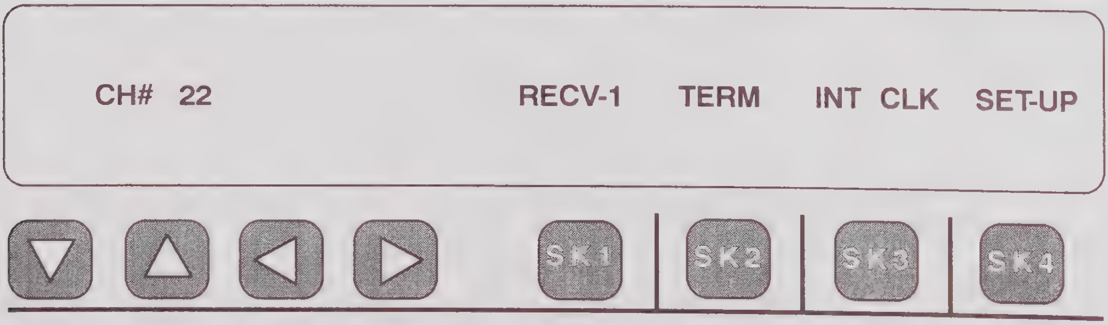


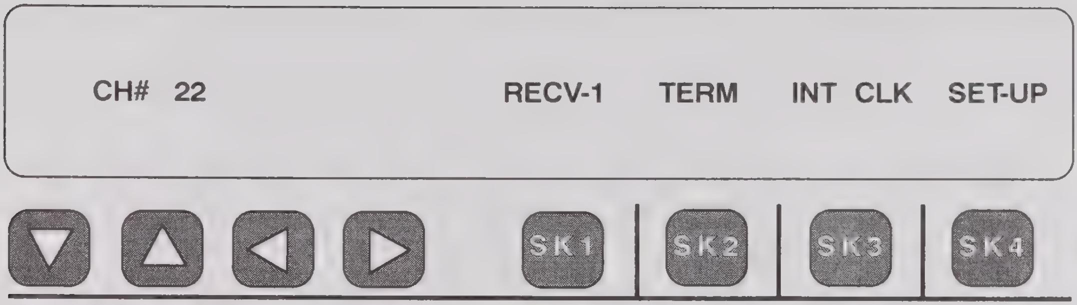
You normally want to be **LOOP TIMED** to the span (**EXT CLK** to the 930A). There are times when you may want to supply clock from the 930A. Then you select **Internal Clock**.

TO SELECT THE CLOCK SOURCE, press Softkey 3 (under **EXT CLK**) and the **CLOCK** display will come up.



The cursor appears over the previous selection (**LOOP-TIME**). To supply clock, press Softkey 4 (under **INTERNAL**) and the 930A display will become:





Internal Clock is only available in the **TERMINATE** mode. The 930A will not insert its clock into a span in the **DROP & INSERT** or **MON-1&2** modes.

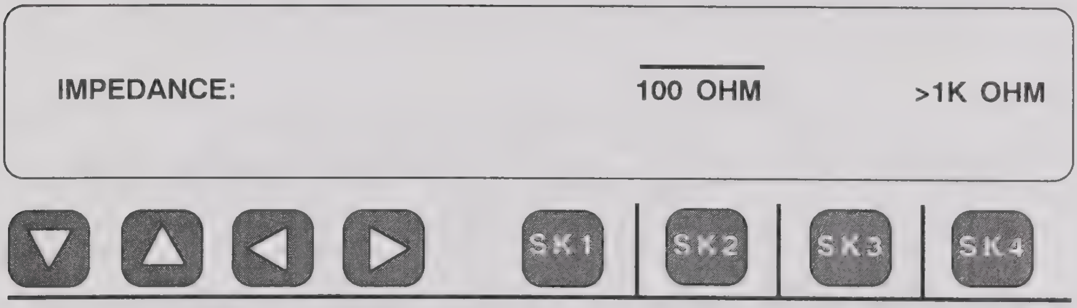
In the **TERMINATE** mode, it is assumed that the T-1 span you are terminating has been taken out of service for test purposes. With the other three modes it is assumed that live traffic may be on the span.

6-1.2 HOW TO CHANGE THE PCM DEFAULT SETTINGS

You do not usually need to change the defaults, but you may want to manually select Extended Superframe, **SLC-96**, or some other parameter. This is where the **SET-UP** menu comes in handy.

TO CHANGE THE DEFAULT SET-Ups, or the set-up you have previously entered, press Softkey 4 (under **SET-UP** above). This will start paging you through the settings. **The cursor appears** above the current selection. You can go directly to the setting you want by pressing the **UP** or **DOWN** Arrow keys, once you are inside the **SET-UP** menu.

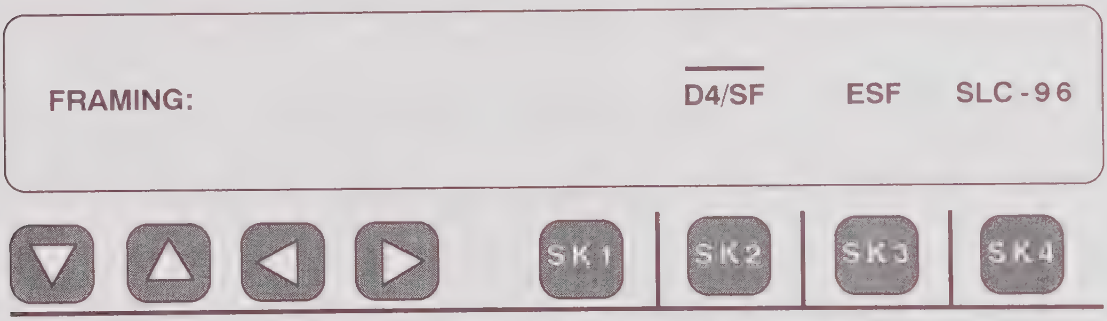
TO CHECK THE IMPEDANCE, you get the following display first:



You should always use the 100 ohm default at the **DSX** jacks (including the Monitor jacks) or at the CSU or Office Repeater jacks. **Use >1K ohms only** in cases where your **DSX does not** supply isolation resistors. Press Softkey 2 (under **100 OHM**) to advance to the next choice.

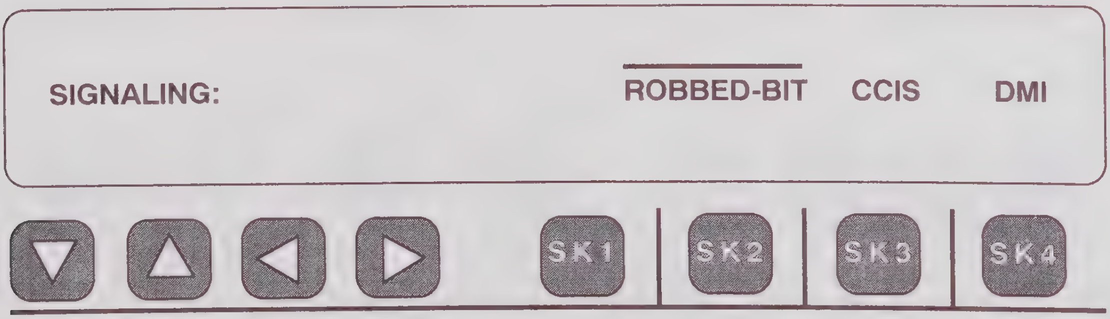
The >1K OHM selection is **not** a normal choice. If you should encounter a problem with false errors or frame loss indications on your 930A, please check to see that someone else has not left your 930A in the **>1K OHM** position. If you leave the 930A in the **>1K ohm** position and connect it to the **DSX Monitor jacks** (which already have 1000 ohms of isolation), the signal will be distorted and cause error indications.

If you know that you need **>1K ohms**, select it by pressing Softkey 4 (under **>1K OHM**) and the 930A display will advance to **FRAMING**.

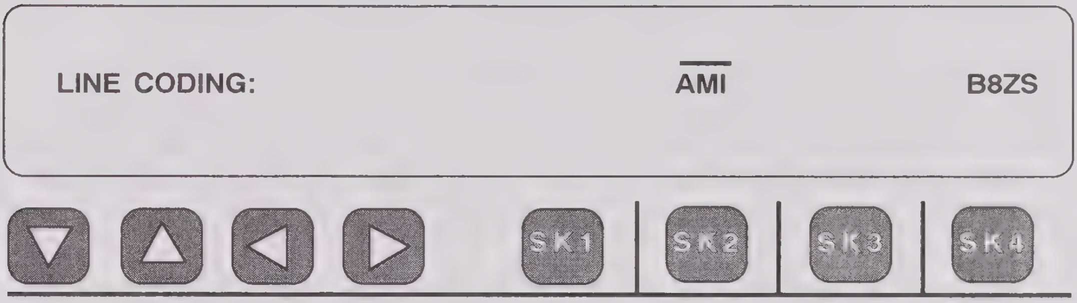


TO CHANGE THE FRAMING FORMAT, you will need to know what kind of span you are on, unless you want the 930A to choose for you. If you want to test on a **SLC-96** system, you must select **SLC-96** by pressing Softkey 4 above. The default selection is **D4/SF** because the standard **D4 Superframe** is the most common framing format in operation. Make your choice by pressing the softkey under what you want.

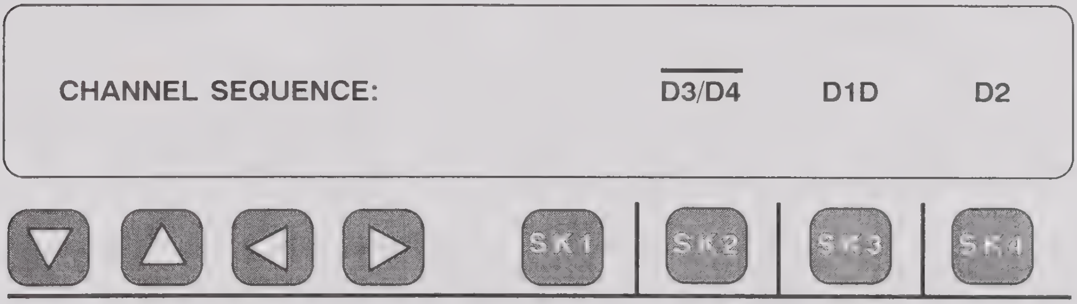
TO CHANGE SIGNALING TYPE, press the softkey under your choice.



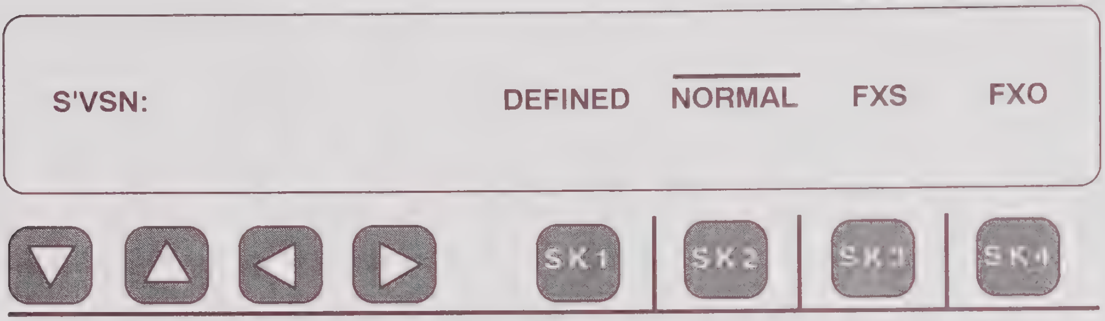
ROBBED-BIT signaling is the most common form of T-Carrier signaling today. In D4 Superframe format, a data bit is "robbed" every sixth and twelfth frame to show **ON** or **OFF HOOK** status. **CCIS** is found on AT&T Toll switches. New switches using **SS7** signaling would also use this format. All 8 data bits are used per channel. All signaling occurs over a separate path from the "talk" path. **Digital Multiplex Interface (DMI)** is a future option for the 930A. The 930A will advance to **LINE CODING** after you make your choice.



TO CHANGE THE LINE CODE, you must know what is on the T-1 span. **B8ZS** is so rare that you will know if you have it. It may be used with **ISDN** service or other service offerings in the future. **Choose** Alternate Mark Inversion (**AMI**) by pressing Softkey 2 and the 930A will go to the **CHANNEL SEQUENCE** display.



TO CHANGE THE CHANNEL NUMBERING SEQUENCE, press the softkey under what you want. If you have **D1D** or **D2** vintage channel banks in your office you will know it. All modern channel banks of the mid-1970s vintage, and up, are **D3/D4** sequential format. You can safely leave the default alone in 99.9% of the cases. After making your selection, the 930A will advance to the last default selection which is **SUPERVISION**.



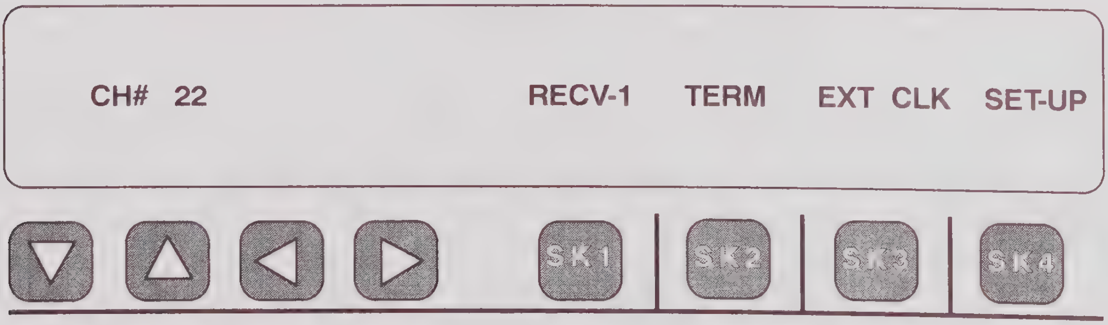
TO CHANGE THE SUPERVISION TYPE, you should know the type of supervision on your T-Carrier span. On a T-Carrier span with Robbed Bit signaling, the supervision (**ON** or **OFF HOOK**) status is conveyed digitally rather than by a DC voltage as it is on analog trunks. On **D4/SF** and **SLC-96** spans you have A and B bits. On **ESF** spans you have A, B, C and D bits.

The default is **NORMAL** and is equal to **E&M** signaling on digital switches. An **ON HOOK** is signalled by the A and B (or A, B, C and D) bits being in a 0 state. An **OFF HOOK**, or busy, is given by these bits going to a 1 state. Option 930A-25 can simulate the Office end or Station end of a **Foreign Exchange** circuit (**FXO** or **FXS**). **DEFINED** mode lets you define the **ON** and **OFF HOOK** states to be any combination of A and B (or A, B, C and D) bits.

Foreign Exchange supervision is explained in detail in a later section along with the **DEFINED** states.

NOTE: The default for each **PCM** parameter is always chosen by pressing Softkey 2 when you are in the **SET-UP** menus. You can use the **UP/DOWN** Arrow keys to page through menus you are not going to change.

When you have made the final selection, the 930A returns to the main **PCM** display.



The 930A remembers all of its settings when you turn it off so it will always come up running with the new default settings you have entered. You need not go to the **SET-UP** menus again unless you want to change something or unless you "Cold-Boot" the 930A which restores the factory defaults.

The following sections will give you examples of how to test your T-1 spans and PCM trunks using the 930A with Option 930A-08E or -09E.

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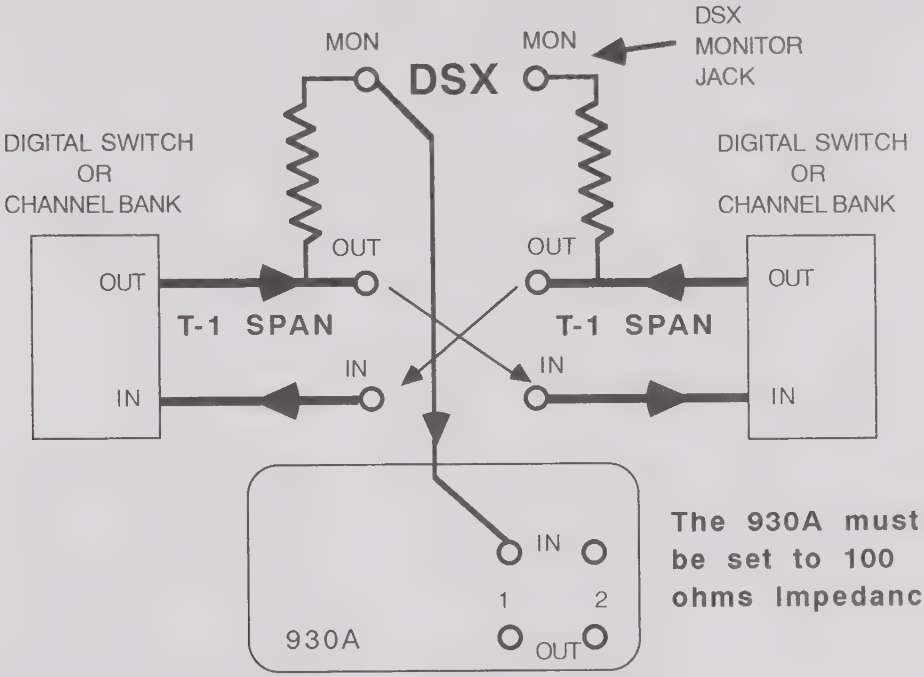
6-2 HOW TO MONITOR A T-1 SPAN

The most basic T-1 test you can make is to monitor the span in one direction. The test cord connection to the **DSX Monitor jack** is shown in Figure 6-2 below:

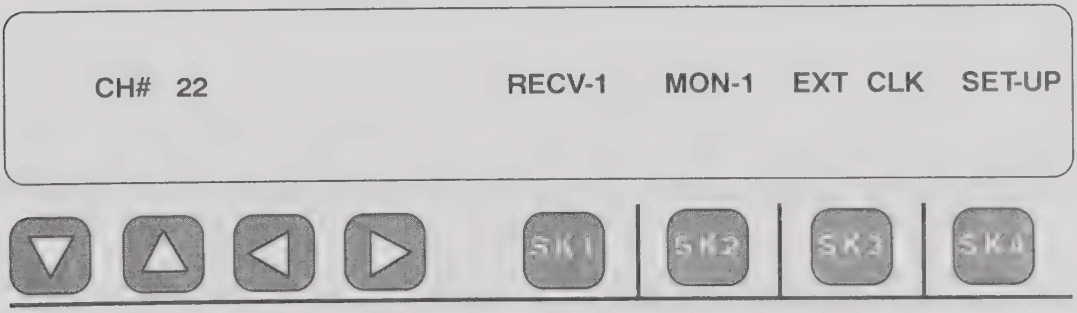


The 930A must be set to 100 ohms Impedance

PCM MODE: MON-1

MONITORING ONE DIRECTION ON A T-1
FIGURE 6-2

All you have to do is connect the 930A's receiver (**PCM IN 1**) to the **DSX Monitor jack** with a test cord and place the 930A in the **MON-1** mode. The 930A display will look like the one below when it is set correctly.


CH# 22 RECV-1 MON-1 EXT CLK SET-UP

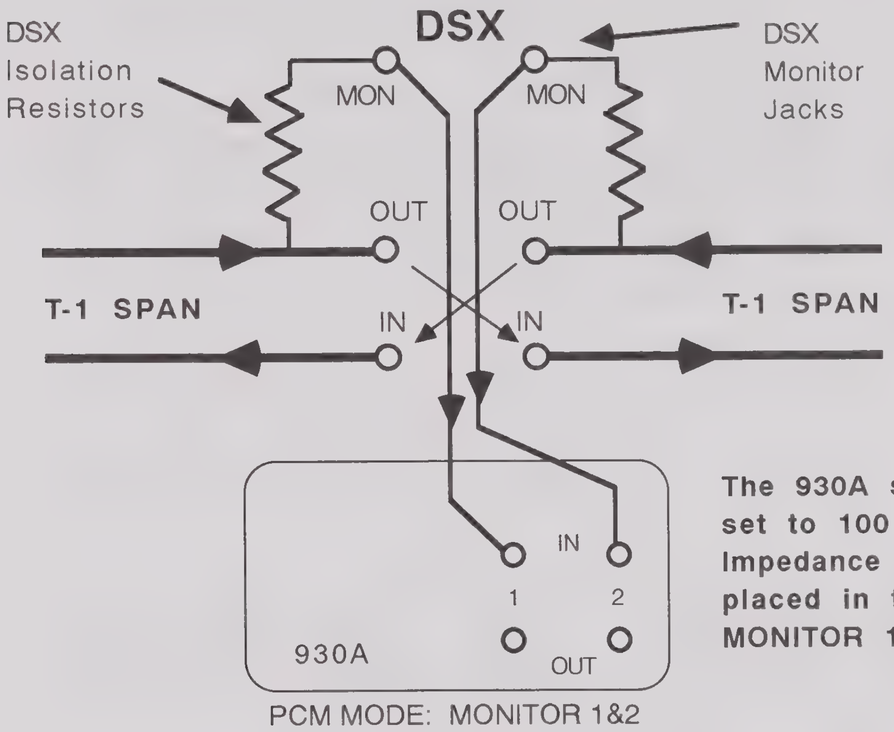
A good question to ask here would be, "What can I test with this?" Well, **you can measure** anything, such as levels and frequencies or noise. You can't do anything active like placing a call or sending a tone or measuring return loss. **You could receive and analyze** the digits of incoming calls if you have purchased Option 930A-01. You could move the test cord to the other monitor jack and capture the digits of the outgoing calls. **You could measure** the wink timing. You could listen to the traffic on the speaker. **You could see** the status of the A and B bits on all 24 channels. **You could count** BPVs, frame slips, frame errors, frame losses and CRC errors (ESF). **You could measure the T-1 voltage** at the DSX Monitor level.

Besides **MEASURE TONE** and **MEASURE NOISE**, you will find that the following menus, under the **OPTION MENU** key, are also useful.

Option Number: 4	DIGIT RECEIVER	Option 930A-01
Option Number: 8	SUPERVISION MONITOR	Standard
Option Number: 9	WINK TIMING	Standard
Option Number: 20	24 BIT DISPLAY	Option 930A-08E/09E
Option Number: 21	TOGGLE A/B BITS	Option 930A-08E/09E
Option Number: 40	SEND PCM ALARMS	Option 930A-08E/09E
Option Number: 41	READ T1 VOLTAGE	Option 930A-08E/09E
Option Number: 42	T1 WANDER	Option 930A-08E/09E
Option Number: 43	T1 ERROR COUNTERS	Option 930A-08E/09E
Option Number: 44	T1 ERROR HISTORY	Option 930A-08E/09E

You will quickly discover that monitoring only one side at a time has its limitations. This is why the 930A has **Option 930A-09E** available. This gives you two receivers (**PCM IN 1** and **PCM IN 2**). Two receivers let you point the finger in the right direction when you have a trouble report.

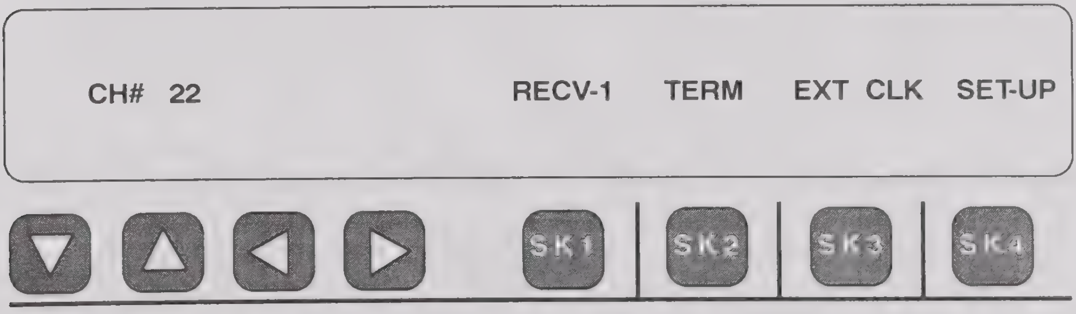
6-3 HOW TO MONITOR BOTH DIRECTIONS ON A T-1 SPAN

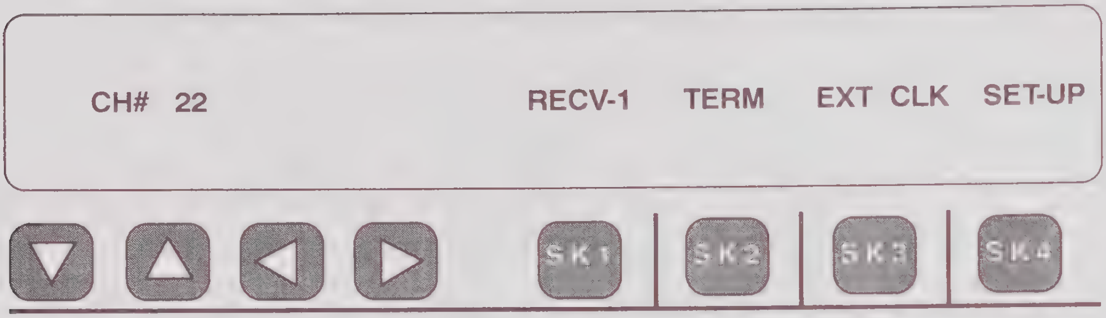


The 930A should be set to 100 ohms Impedance and placed in the MONITOR 1&2 mode.

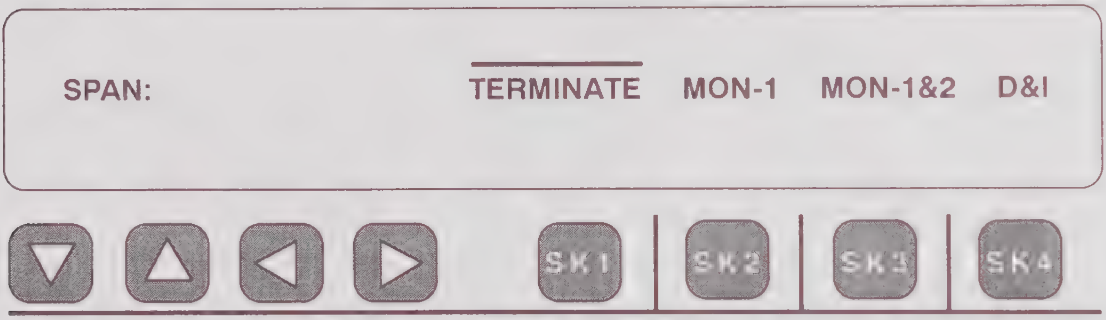
DUAL DIRECTION MONITORING WITH THE 930A
FIGURE 6-3

If you have purchased Option 930A-09E, you can "look both ways" at the same time. From the diagram above, the test cord connections are from the 930A receivers (**PCM IN 1** and **PCM IN 2**) to the **DSX Monitor jacks**. The 930A itself has to be set to the **MON-1&2** mode. The process starts from the default **PCM** display.

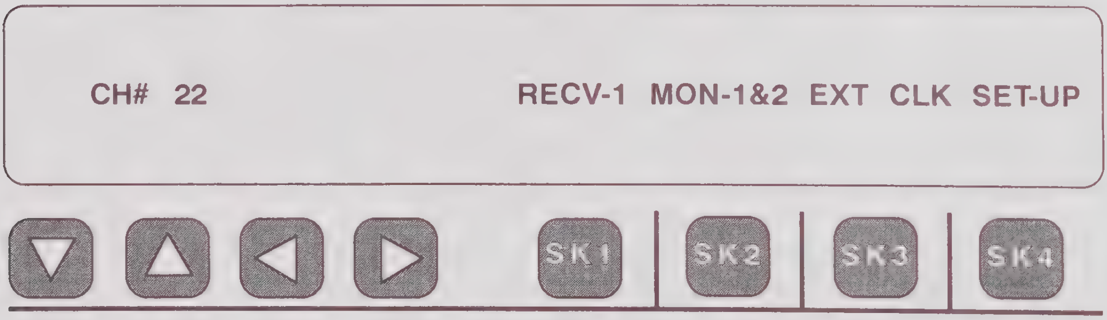

CH# 22 RECV-1 TERM EXT CLK SET-UP



To change the mode of testing, press Softkey 2 (under **TERM**) and your choices will appear as:



To monitor both sides of the T-1 span, press Softkey 3 (under **MON-1&2**) and the 930A does the rest. The main PCM display changes to:

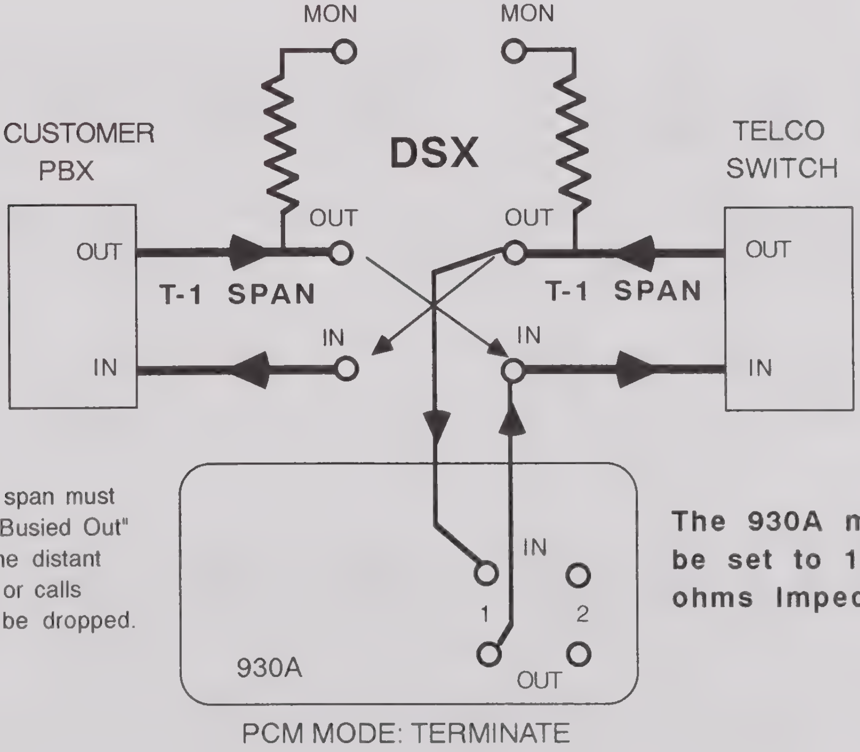


You could be on any channel; channel 22 is only an example. You now have the capability to perform all of the measurements mentioned under single direction monitoring on both sides at once. You can switch between sides by simply pressing Softkey 1 (under **RECV-1**) now instead of moving test cords around. This toggles between **RECV-1** and **RECV-2**.

6-4 TERMINATING A T-1 SPAN FOR OUT-OF-SERVICE TESTING

For testing trunks on out-of-service T-1 span lines (pre-cutover or turned down for maintenance), the 930A can generate, as well as receive, a DS-1 signal. You might use this mode of testing to "turn up" channel banks, or to act as a distant end switch, or PBX, into your switch. When you are in the **TERMINATE** mode, all of the 930A's functions are active; not just receiving functions, but sending as well. You can originate a call, send a tone, do return loss testing, or any of the other active data tests. You can even send digital patterns to do Bit Error Rate Testing (**BERT**) if you purchased Option 930A-22.

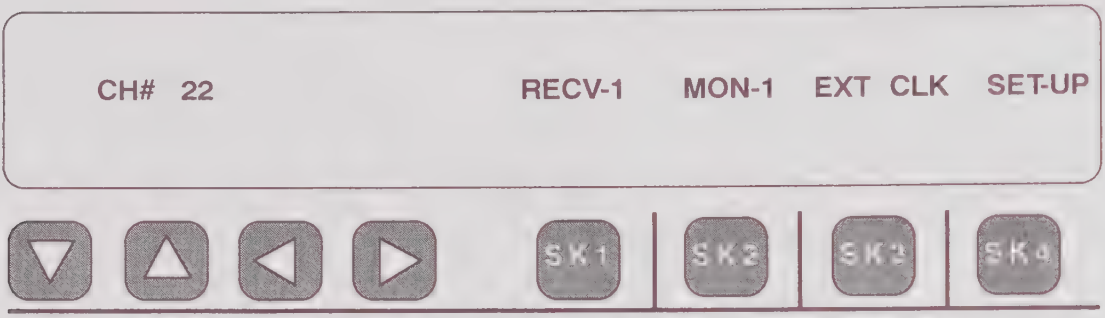
Once you have "busied out" the T-1 span you are ready to connect the 930A toward the switch, channel bank, etc., you want to test. The test cord connections at a standard **DSX** are shown below:



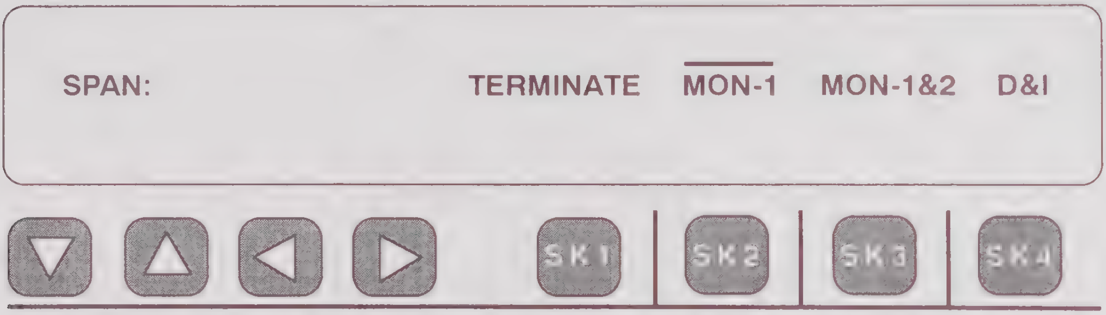
NOTE: The span must be "Busied Out" at the distant end or calls will be dropped.

The 930A must be set to 100 ohms Impedance

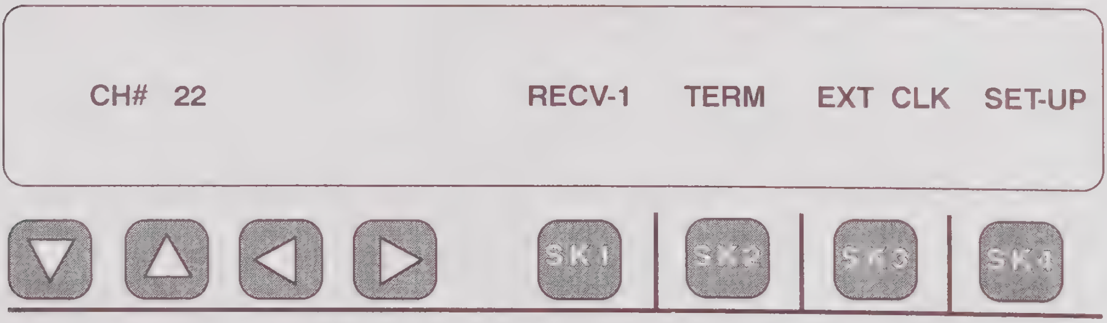
TERMINATING A T-1 SPAN FOR OUT-OF-SERVICE TESTING
FIGURE 6-4



To set the 930A into the TERMINATE mode, press Softkey 2 (under **MON-1** in the example above) and the choices appear on the display as:

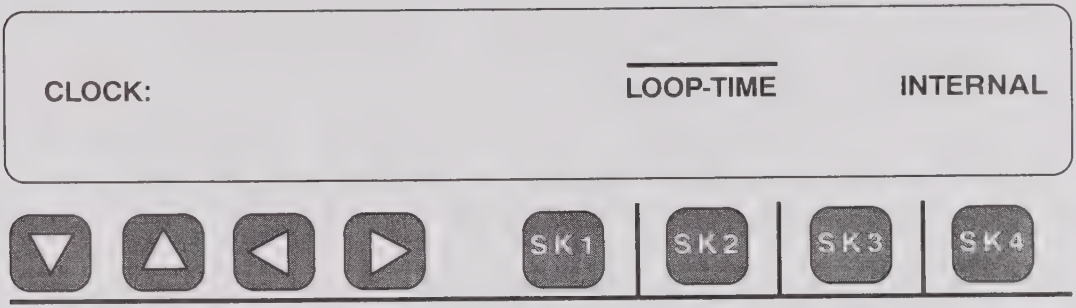


To Terminate the span, press Softkey 1 to choose the **TERMINATE** mode. The 930A display will come back as:

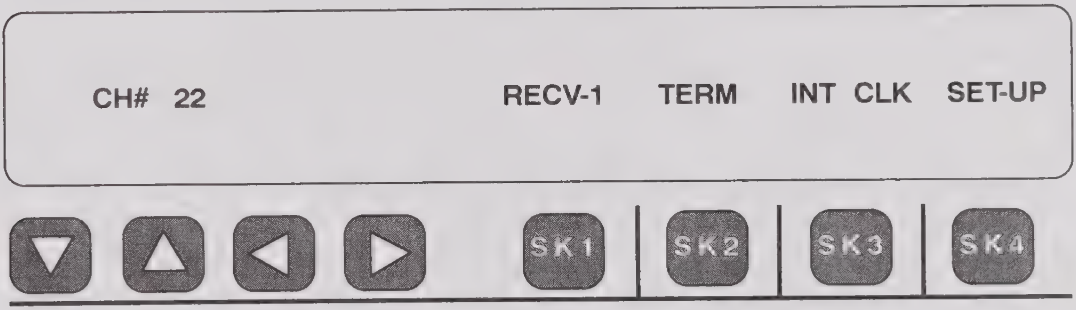


Unlike the other modes, **TERMINATE** gives you a choice of Clock Source. You can be **Loop-Timed** to the span clock, or you can have the 930A supply the clock. The display above shows Loop-Timing.

If you know you need to supply the clock from the 930A, press Softkey 3 (under **EXT CLK**) and your choices will appear on the display shown below:



If you want the 930A to supply the T-1 clock, press Softkey 4 (under **INTERNAL**) and the main **PCM** display will reappear as:



In either case, you are ready to begin testing. You can use **DIAL/RING** to place a call into the switch, the **RETURN LOSS**, **SEND TONE**, **MEASURE TONE** and **MEASURE NOISE** functions. Under the **OPTION MENU** key, the standard features which come with the 930A, and which are of particular use in this mode, are Option Menus 1, 2, 8, 9, 10, 12, 15, 30, 31, 32 and 33. If you purchased options such as the Digit Receiver/Analyzer, Bit Error Testing, or the VF Data Tests, their menus will also be of interest to you.

Trunk transmission and signaling can be tested completely before the trunk is placed in service using the **TERMINATE** mode to simulate either end of a circuit. Place the 930A in **EXT CLK** mode to simulate the loop side of the circuit toward a switch. To test toward the loop (simulate the switch toward the customer) simply set the 930A to **INT CLK** mode and transfer the test cords to the **DSX** jacks looking out toward the Office Repeater or the customer's CSU.

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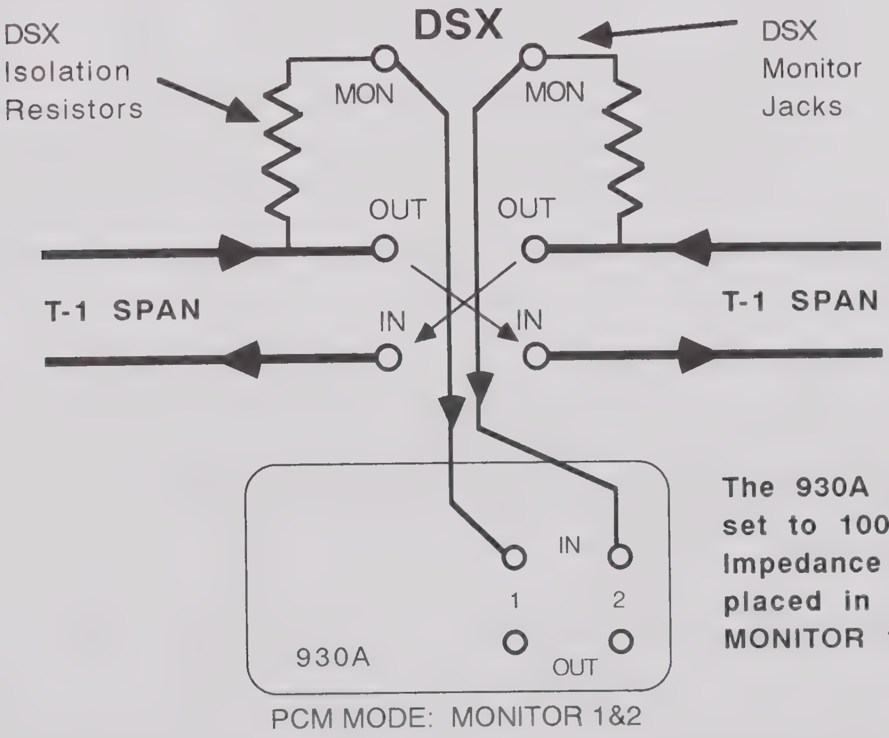
6-5 DROP AND INSERT TESTING ON A T-1 LINE

This mode of operation requires you to understand the **DSX** jackfield and what it does for you and to you. You can insert test cords into the **Monitor jacks** and do no harm to service. You can have your switch take a span out of service and test on it without bothering customers. If you want to do Drop and Insert testing on a working T-1 span with traffic on it, you have to exercise a little care. If you read the following paragraphs, and use the 930A accordingly, you will minimize any service interruptions.

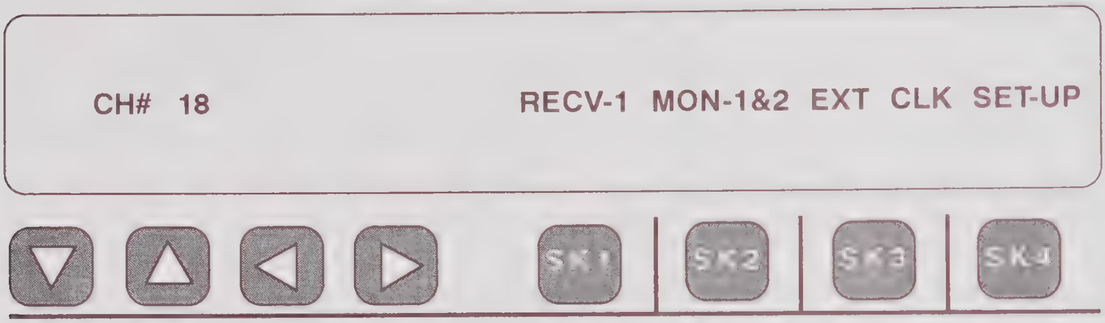
The procedure for Drop and Insert testing is purposely a two stage process when using the 930A. You monitor both directions of transmission using the **MON-1&2** mode first and try to solve your problems. In probably 85 to 90% of the cases, this is all you need to do to find the direction of the problem, and its source. **MON-1&2** is the logical first step toward a **D&I** test set up. You begin by connecting the 930A to the DSX monitor jacks just as you did for dual direction monitoring in Section 6-3. The diagram is repeated below:



The 930A should be set to 100 ohms Impedance and placed in the MONITOR 1&2 mode.

PREPARATION FOR DUAL DIRECTION DROP AND INSERT
FIGURE 6-5

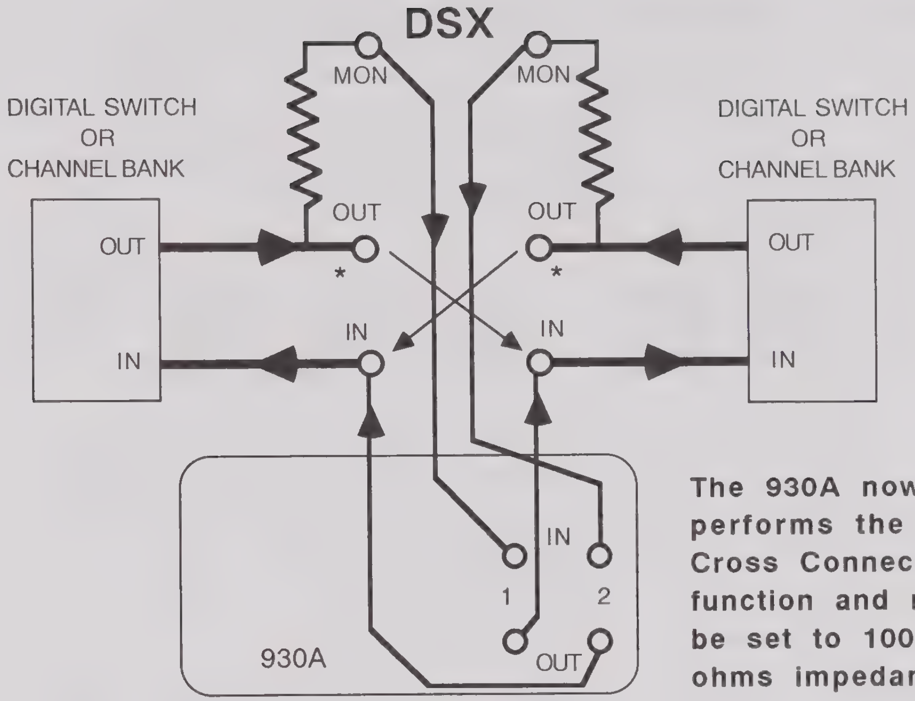
The 930A display should look like the one below when you have correctly set up the main PCM display.



The channel number could be any one of 24. You may, for example, have to originate a call on PCM channel 18 toward a PBX at the far end of the circuit.

The next step in the process is to leave the 930A set to **MON-1&2** and connect test cords from **PCM OUT 1** and **PCM OUT 2** to the input jacks on the DSX. **Warning!** This is where you run the risk of momentarily opening the span because the **DSX** jacks are "break-before-make" types. **You will also need 100 ohm termination plugs to plug into the output jacks of the DSX to keep the span from oscillating**. If you do take a "Hit" for any reason you will see a remote alarm indication on your 930A for a few seconds while the span reframes. The customers who were talking are now trying to reconnect themselves to whomever they were talking to. **You may want to consider doing this type of testing out of hours, and certainly during off peak hours.**

The connection diagram, Figure 6-6, is shown on the following page. Bear in mind that you can also do this at a T-1 CSU, or an Office Repeater, since they also have jacks. **But** they use different terminology than the DSX, so you may have to get out their wiring diagrams to figure out how to connect the test cords to them. No two brands seem to use the same terms which is why we do not show an example.



The 930A now performs the Cross Connect function and must be set to 100 ohms impedance.

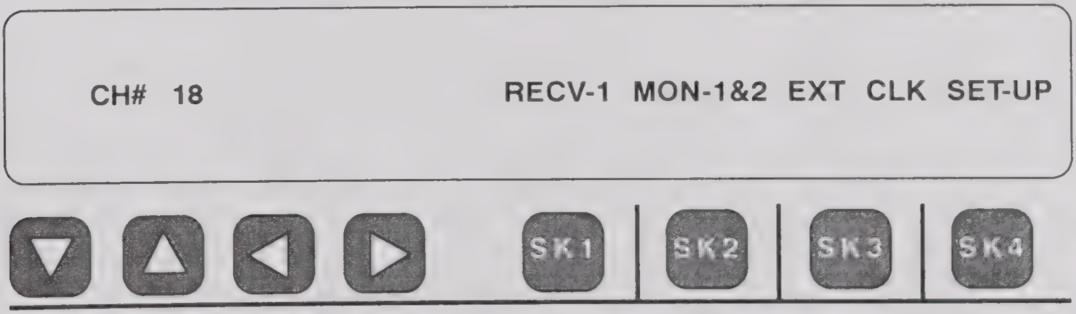
PCM MODE: MON-1&2

(* 100 Ohm Termination Plugs Required)

TEST CORD CONNECTIONS FOR DROP AND INSERT TESTING
FIGURE 6-6

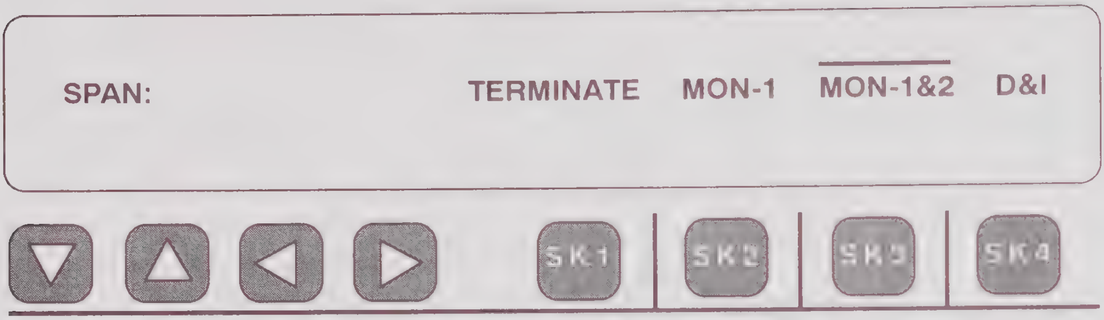
Be sure to place 100 ohm terminating plugs into the DSX output jacks as shown above to prevent the span from oscillating.

The final step is easy, now that the worst is over. Once you have all four test cords connected and the terminating plugs in, all you have to do is choose the **D&I** mode of operation on the 930A. **You start from the main PCM** display which was set to **MON-1&2** as repeated below:

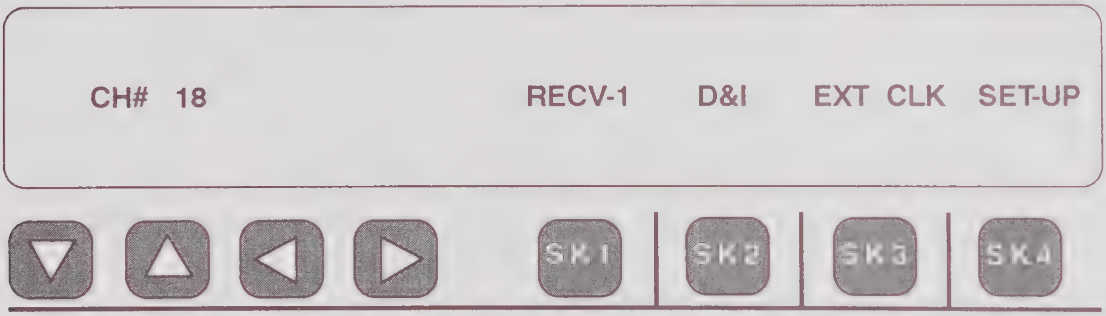


```
CH#  18                    RECV-1  MON-1&2  EXT  CLK  SET-UP
```

Press Softkey 2 (under **MON-1&2**) and your choices will appear as:

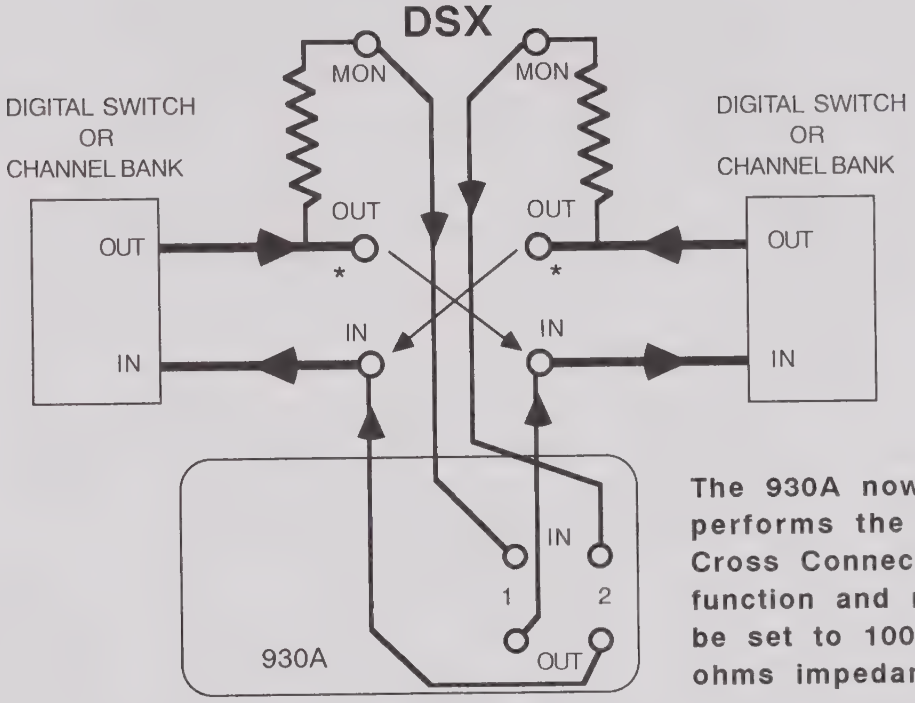

SPAN: TERMINATE MON-1 MON-1&2 D&I

Note that the cursor now appears over MON-1&2 which is the mode you were in. Press Softkey 4 (under **D&I**) and the currently selected channel will be dropped (the other 23 channels pass through undisturbed). **Make sure the channel is idle before selecting D&I**.


CH# 18 RECV-1 D&I EXT CLK SET-UP

This part of the process is hitless which means that once you have the four test cords inserted, you are past the danger of dropping the span. In this example, the 930A has seized channel 18. The other 23 channels are passing, uninterrupted, through the 930A. The 930A will not allow you to change PCM channels in the **D&I** mode. If you try, it will beep at you and go into the **MON-1&2** mode. You will not be able to go **OFF HOOK**, send tones, place calls, etc., until you go back and change to the **D&I** mode as described above. This safety feature helps keep you from dropping or interrupting customer traffic.

The diagram below shows the test cord connections which are the same for the **D&I** and **MON-1&2** modes.


DSX
MON
MON
DIGITAL SWITCH OR CHANNEL BANK
DIGITAL SWITCH OR CHANNEL BANK
OUT
OUT
OUT
OUT
*
*
IN
IN
IN
IN
IN
1
2
930A
OUT

The 930A now performs the Cross Connect function and must be set to 100 ohms impedance.

PCM MODE: D&I

(* 100 Ohm Termination Plugs Required)

DUAL DIRECTION DROP AND INSERT
FIGURE 6-7

In the MON-1&2 mode the 24 PCM channels on the span are passed through the 930A as though it were in series in the span. The 930A is essentially "Bridged" onto the span in the **MONITOR** mode. Once connected, as shown in Figure 6-7, it is easy to go from **D&I** to **MON-1&2** and back with the 930A since you do not have to change the test cords. You can now make every measurement, or active test, which the 930A can perform, and which makes sense to do on a T-1. The 930A will tell you if you try to select something which does not make sense (i.e., DC Voltmeter).

The following sections give some specific examples of tests you can make on T-1 spans with the 930A.

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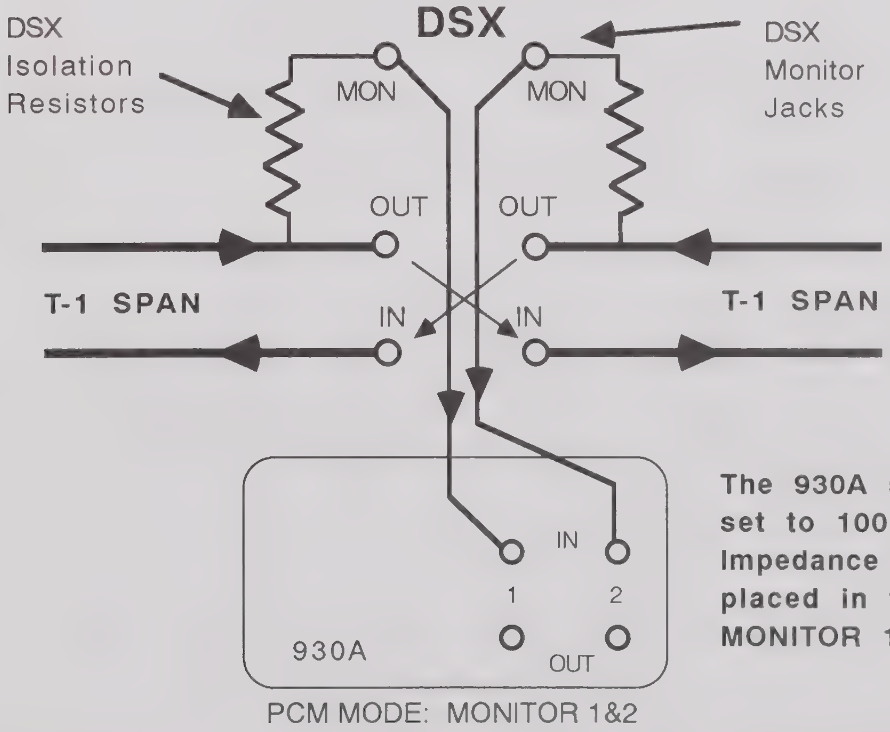
6-6 HOW TO MEASURE FRAME SLIPS, BPVs AND OTHER ERRORS WITH THE 930A (MENU OPTION 43)

Once you have selected the PCM Trunk Type and connected the 930A to the T-1 span, the 930A automatically monitors for, and counts, Frame Slips, Frame Errors, Bipolar Violations (BPV), Frame Losses and CRC Errors (CRC errors apply only to the ESF mode). You do not have to do anything to the 930A other than connect it to the span.

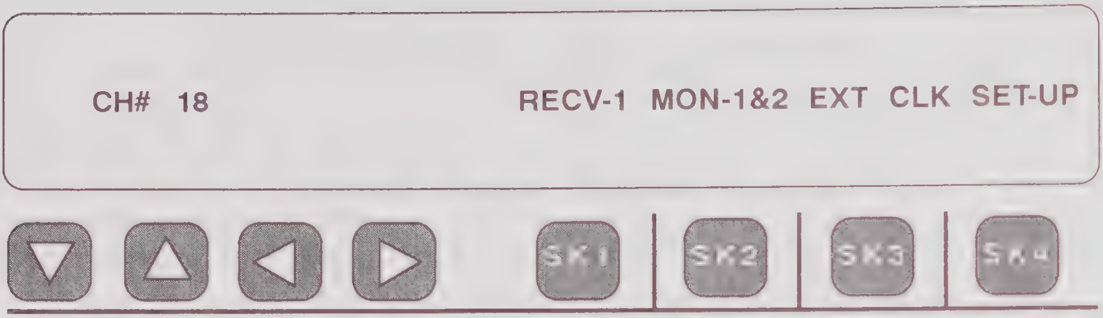
The 930A display will momentarily interrupt what it is showing you to flash the error messages on its screen if you are not in Menu 43. If you are in a dual direction mode such as **MON-1&2** or **D&I**, it will also show you which direction the error came from.

To count errors, go to **Menu Option 43: ERROR COUNTERS**. To demonstrate the procedure, the **MON-1&2** mode example will be used. The test connection diagram is shown below:



The 930A should be set to 100 ohms Impedance and placed in the MONITOR 1&2 mode.

TEST CORD CONNECTIONS FOR ERROR MONITORING
FIGURE 6-8

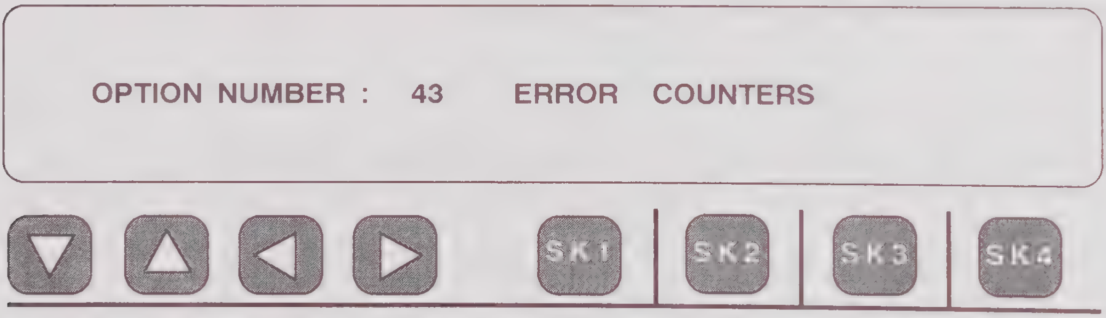


When the 930A is in the **MON-1&2** mode, and connected to the DSX monitor jacks, errors will accumulate as they occur. You may be in the main PCM display, on any channel. **To view the errors**, do the following:

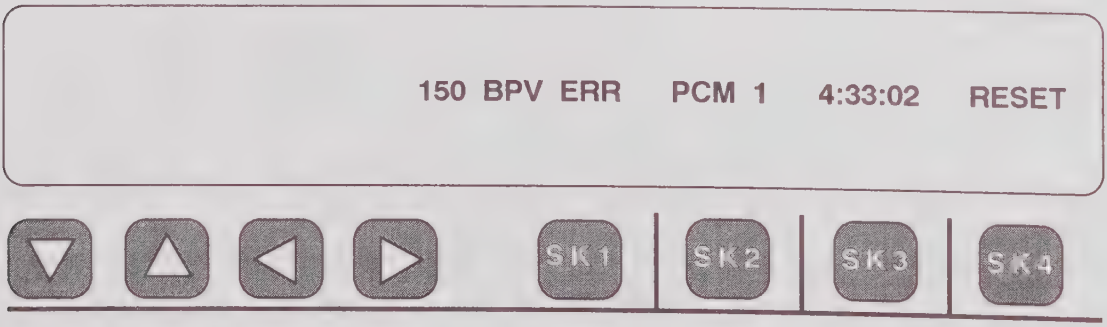
Press the OPTION MENU ● ○ Option Menu function key.

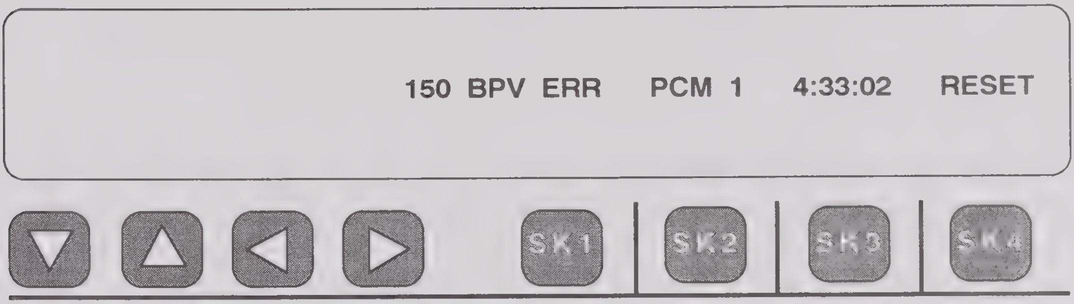
Use the UP/DOWN ▽ △ arrow keys to

get to Menu Option 43: ERROR COUNTERS.



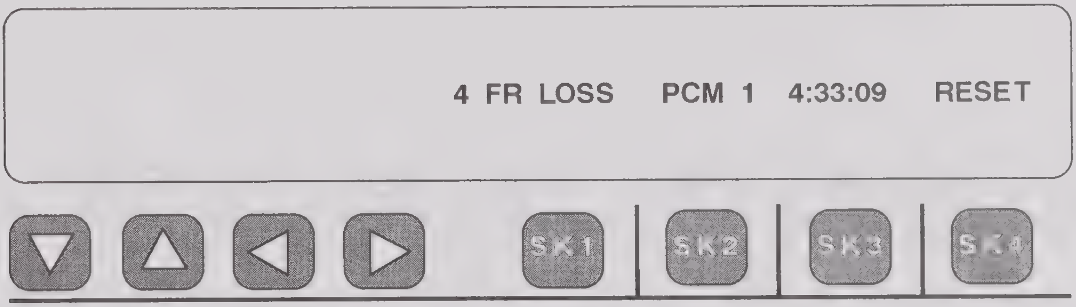
Press any softkey under the display and the current display of the error counts will be shown. For example, it might look like:



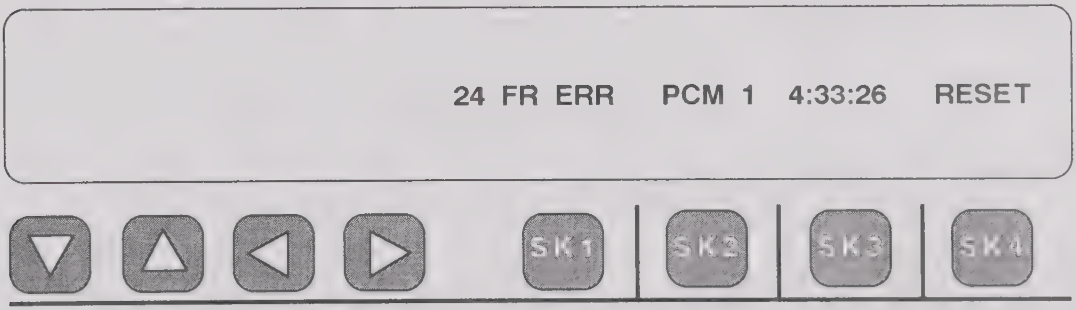


```
150 BPV ERR    PCM 1    4:33:02    RESET
```

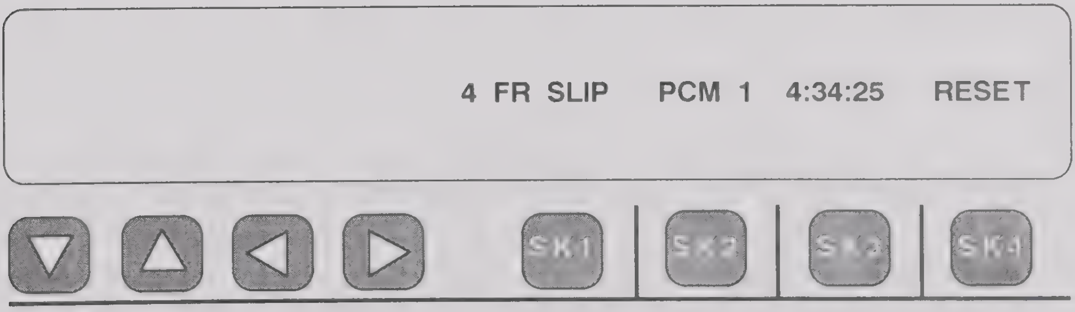
By pressing Softkey 1, or the **UP/DOWN** Arrow keys, you can page through the other counters to show you the Frame Losses, Frame Errors (or CRC Errors in ESF) and Frame Slips. Some example displays are:



```
4 FR LOSS    PCM 1   4:33:09    RESET
```



```
24 FR ERR    PCM 1   4:33:26    RESET
```

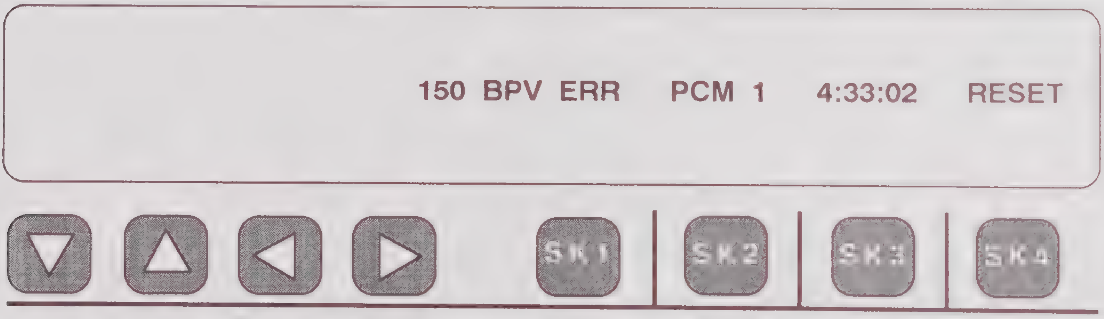


```
4 FR SLIP    PCM 1   4:34:25    RESET
```

As you can see in this example, side 1 does not look too good. But what about side 2?

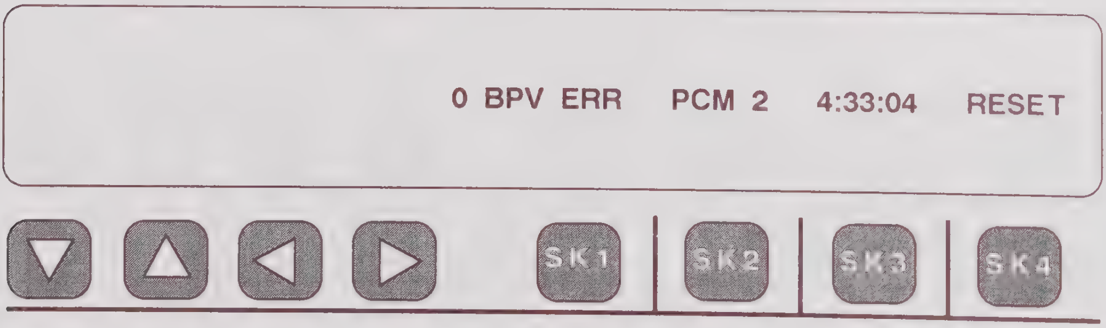
Since you are in the **MON-1&2** mode, you can easily check what is on side 2 by pressing Softkey 2 to toggle back and forth from side 1 to side 2. The 930A has independent counters on each side so you can see where the problems come from. This is like having two error counting test sets connected to the T-1 span. For this example, suppose you wanted to compare the Bipolar Violation counts on side 1 to those on side 2.

Let's say that side 1's counter is:



150 BPV ERR PCM 1 4:33:02 RESET

Now, press Softkey 2 and the display shows side 2 as:



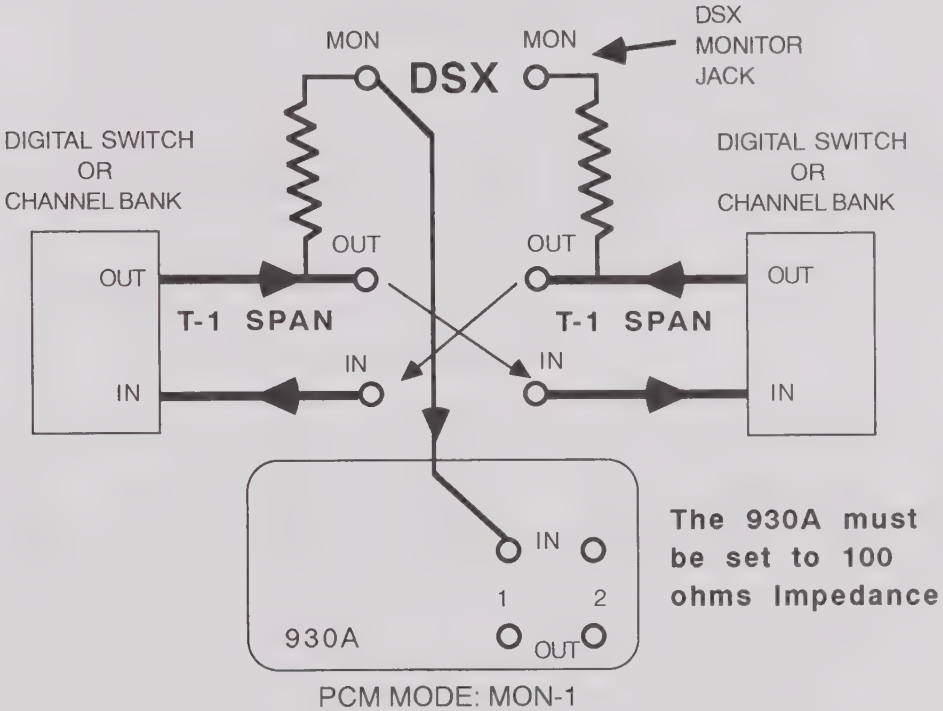
0 BPV ERR PCM 2 4:33:04 RESET

The conclusion is obvious. We need to do some serious testing toward side 1 because the problem is coming from that direction.

The parameters measured by the 930A in Menu Option 43 are: BPV Errors, BPV Rate, Frame Errors, Bit Slips, Frame Slips, Frame Losses, No PCM, Error Free Seconds, %EFS, Errored Seconds, %ES, Severely Errored Seconds, %SES, Failed Seconds, %Failed, Available Seconds, %Available, Unavailable Seconds and %Unavailable Seconds. All measurements are in accordance with CCITT G.821.

6-7 HOW TO MEASURE THE T-1 VOLTAGE AT THE DSX JACKS (MENU OPTION 41)

To measure the positive and negative base-to-peak voltages, connect one, or both, of the **PCM** receivers to the **DSX**. For example, take the case of a 930A in the **MON-1** mode connected to the monitor jack on a **DSX**.



The 930A must be set to 100 ohms Impedance

MEASURING T-1 VOLTAGE AT THE DSX MONITOR JACK
FIGURE 6-9

You should know what voltages are expected at this point to make sense out of the readings. For instance, if you plugged into the **DSX** output jacks, you would expect to see about ±3.0 Volts base-to-peak. At the monitor jacks, however, you should expect to see about one tenth the voltage, or roughly ±0.3 volts base-to-peak. You should not read less than ±0.2 volts base-to-peak at the DSX Monitor jack. If you do, this indicates a possible problem on the span. It could be a problem with a repeater, a defective cable, poor equalization, or too long a cable run from the equipment to the DSX.

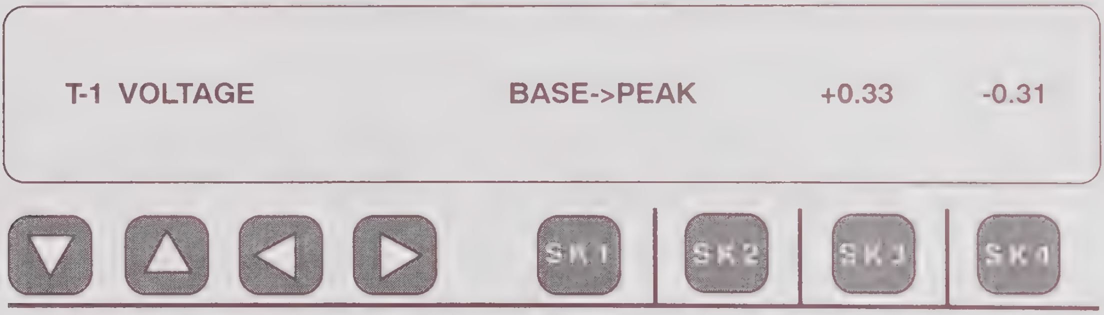
You measure the voltage on the 930A from Menu Option Number 41: **READ T-1 VOLTAGE** after you have set the PCM Trunk Type and connected the test cords to the DSX.

Press the OPTION MENU ■ ○ Option Menu function key.

Use the UP/DOWN ▽ △ arrow keys to

get to **Menu Option 41: READ T-1 VOLTAGE**.

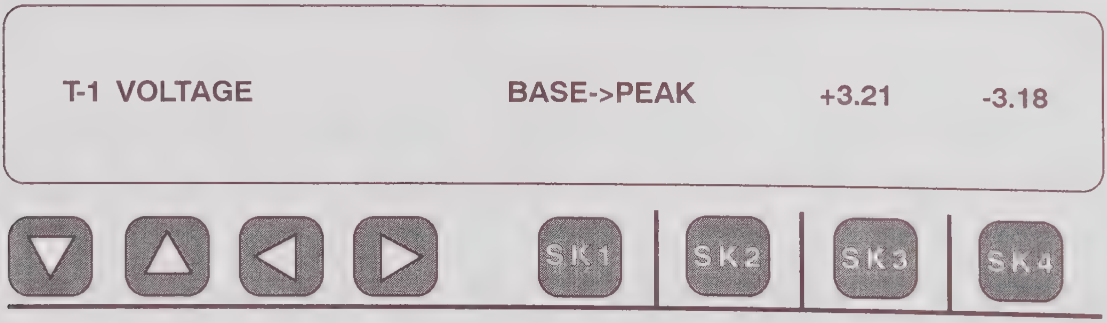
Press any softkey to get into the main menu and the 930A will display its readings as Base-to-Peak voltage. An example of a typical reading at the **DSX Monitor** jack is shown below.



T-1 VOLTAGE BASE->PEAK +0.33 -0.31

This is about what you would expect, give or take a tenth of a volt. You would expect problems if these readings were below ±0.2 Volt. That might indicate that you had cable runs in excess of the **DSX** limitations. Then you might have to put your signal through a bridging repeater first.

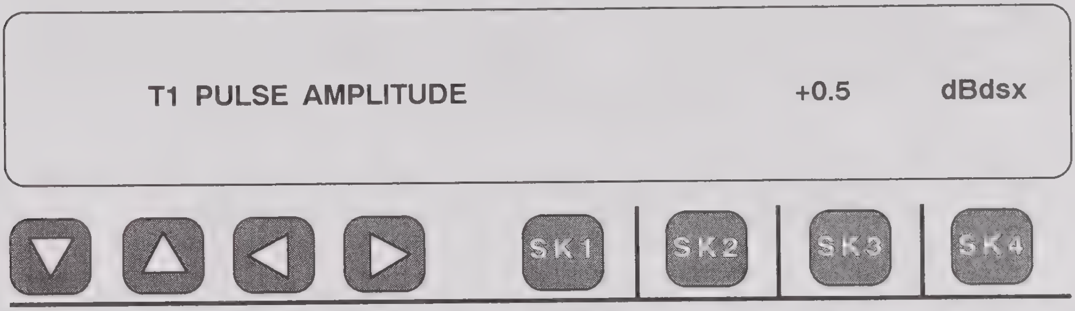
If you were to measure the voltage **directly at the DSX output**, then you would see a display that would look more like the one below.



T-1 VOLTAGE BASE->PEAK +3.21 -3.18

You can see from this that the positive and negative going peaks are close to each other in terms of absolute value. If they were very different from each other (more than 0.5 Volt), or if they were much higher or lower than the nominal 3 Volts (say ±6.0 Volts), you would expect to have problems.

To read the T-1 pulse amplitude in dBdsx instead of voltage, press any softkey under the display and the display will become:



```
T1 PULSE AMPLITUDE          +0.5     dBdsx
```

3.0 Volts base-to-peak is equal to 0.0 dBdsx. Readings between 0 and 1 dBdsx would be expected at the DSX output jacks. Readings of about -20 dBdsx would be expected at the DSX Monitor jacks.

6-8 TO CHECK A/B/C/D BIT STATES ON ALL 24 CHANNELS (MENU OPTION 20)

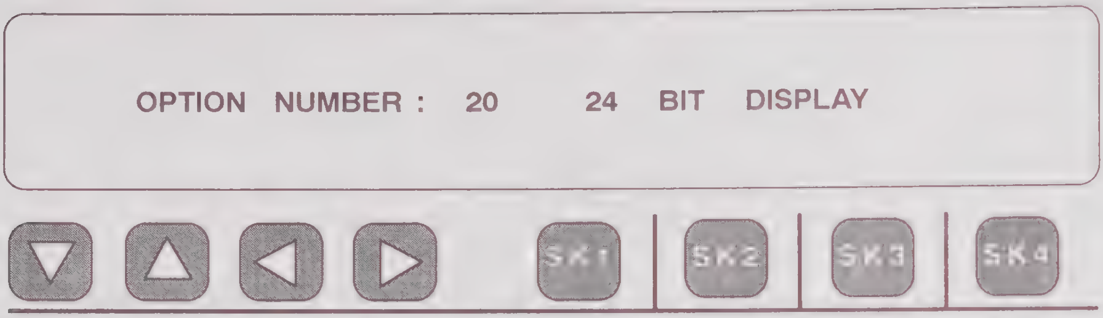
When you are working on a T-1 span, it is sometimes very useful to be able to see the state of the A and B bits (also C and D bits on ESF) on all 24 channels simultaneously. With the 930A, you can see these bits at the DSX monitor jacks, and you can check them in one direction (Option 930A-08E), or in both directions (Option 930A-09E).

To look at the supervision states, all you have to do is connect your 930A to the DSX as shown in Figures 6-2 or 6-3. Make sure the 930A is set to the PCM Trunk Type and that default settings are correct. If it is set to the **MON-1** mode, you will be able to look at the supervision bits on one side at a time. If you are in the **MON-1&2** mode, you can switch from **RECV-1** to **RECV-2**, and look at the supervision bits in both directions. When the 930A is set-up, do the following:

Press the OPTION MENU ■ ○ Option Menu function key.

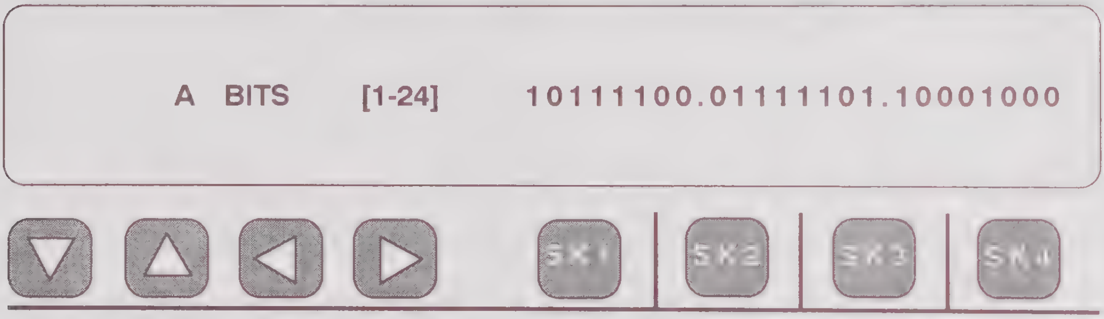
Use the UP/DOWN ▽ △ arrow keys to

get to **Menu Option 20: 24 BIT DISPLAY**.



OPTION NUMBER : 20 24 BIT DISPLAY

Press any softkey under the display and the A bit display will come up. An example appears below:



A BITS [1-24] 10111100.01111101.10001000

The channels are numbered from 1 to 24, left to right. The bits have two states, 0 and 1. Usually a 0 indicates On Hook and a 1 indicates Off Hook or busy. On a working span, you will see calls completing and terminating, so the display will be changing constantly as calls come and go. Pressing any softkey or arrow key will page you through the B bit display. On an Extended Superframe span, you will also get the C and D bit displays. **Remember**, for the time being, **ESF** gangs the A and C bits, and B and D bits, together. Looking at the A and B bits will be enough.

If you are in **PRINTER** Remote mode, the 930A will print a copy of it's display whenever a bit changes. In **COMPUTER** remote, it will send a Bell (ASCII 07) to the computer.

6-9 TO MANUALLY TOGGLE THE A/B/C/D BITS OR VIEW BOTH DIRECTIONS SIMULTANEOUSLY (MENU OPTION 21)

Normally, you go **ON** and **OFF HOOK** by using the front panel Hook Switch. The 930A also provides you with Menu Option 21 which gives you complete control over the A/B/C/D bit states. This Menu Option also lets you view the A/B/C/D bit status on the selected channel in both directions when you are in the **MON-1&2** mode. **You can set the states of your supervision bits** manually from Menu Option 21: **TOGGLE A\B BITS**.

Press the OPTION MENU ○ **Option Menu** function key.

Use the UP/DOWN ▽ △ arrow keys to

get to Menu Option 21: TOGGLE A\B BITS.

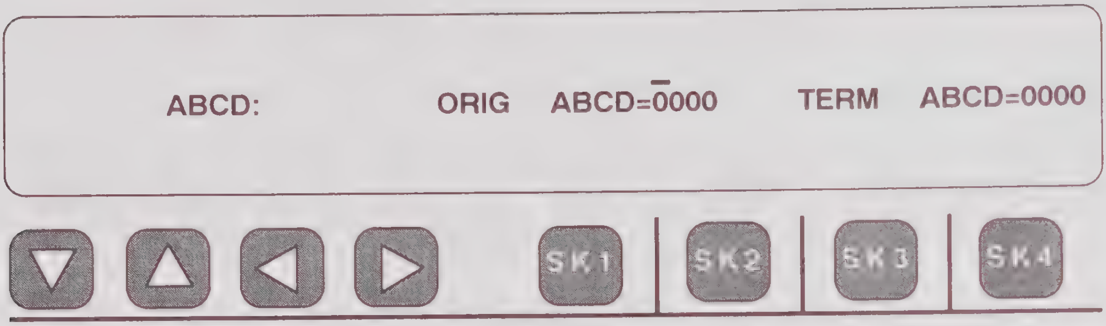
Once you get to this menu, the front panel Hook Switch is disabled, and control of the **ON** and **OFF HOOK** states lies with this Menu Option.

OPTION NUMBER : 21 TOGGLE A\B BITS

Press any softkey under the display, and depending upon whether you are on a D4 Superframe, or Extended Superframe T-1 span, the display will come up as one of the following. **For normal D4 Superframe:**

AB: ORIG AB=$\overline{0}$0 TERM AB=00

For Extended Superframe:

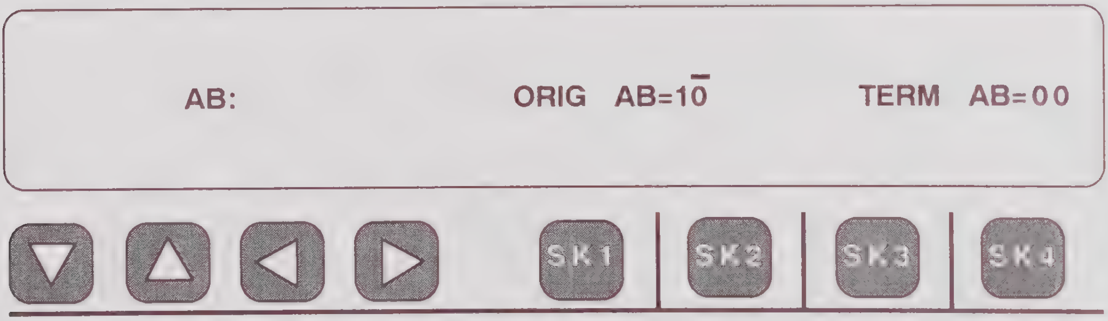


ABCD: ORIG ABCD=$\overline{0}$000 TERM ABCD=0000

In both of these examples, the originating end is **ON HOOK** since the states of the bits are all 0.

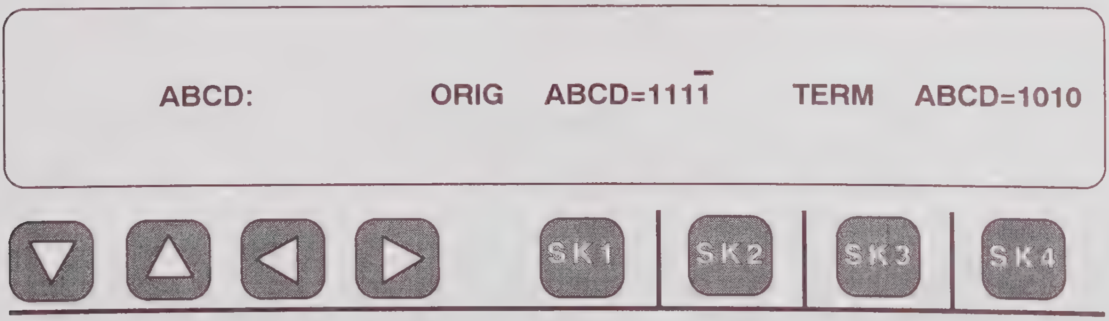
Note that the cursor is flashing over the first digit (the A bit) in both cases.

To change the state of the A bit to a **1**, press **1** on the keypad and the A bit will be changed. The cursor will then move over the next digit.

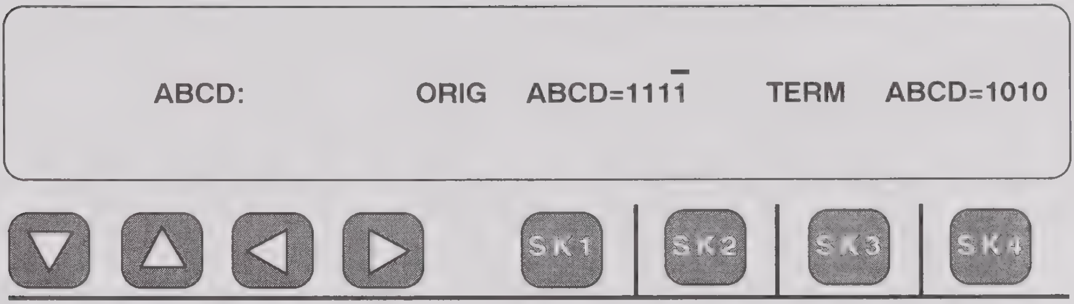


AB: ORIG AB=1$\overline{0}$ TERM AB=00

You could scroll down the line and change all the bits to a 1 state. In **ESF** this would look like:



ABCD: ORIG ABCD=111$\overline{1}$ TERM ABCD=1010



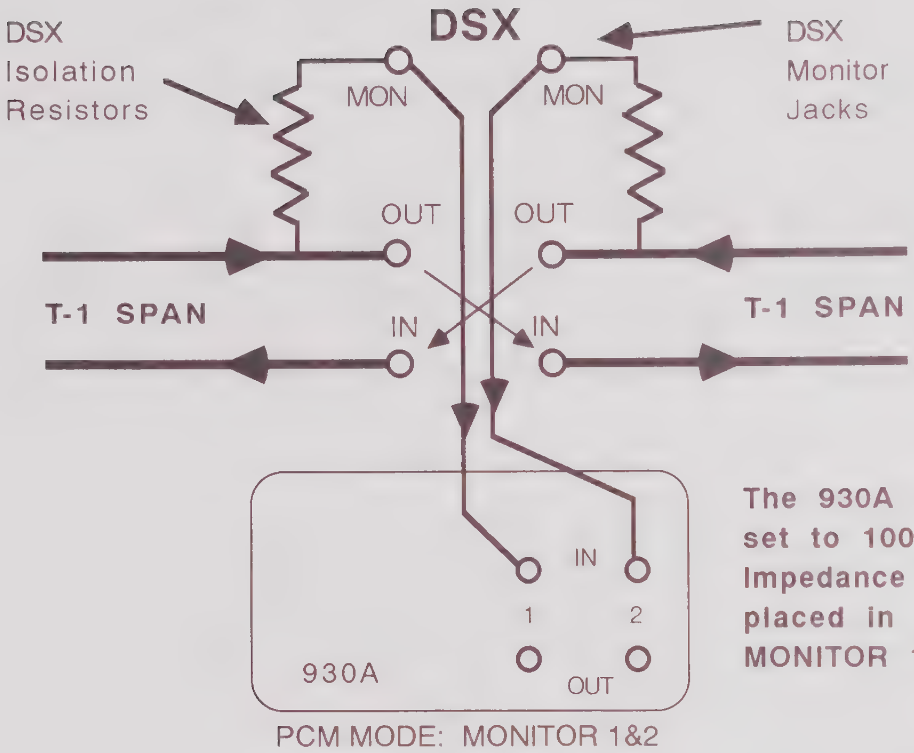
```
ABCD:        ORIG   ABCD=1111      TERM   ABCD=1010
```

The **TERM** side shows the state of the supervision being returned from the far end of the circuit. In the above example you see that the B and D bits never went high.

The **TERM** bits come from the **PCM IN** jack in the **RECV** direction (**PCM IN 1** for **RECV-1**). In **TERMINATE** or **MON-1** modes, the **ORIG** bits come from the 930A. In **MON-1&2** or **D&I** modes, the **ORIG** bits come from the other direction. In all cases, **TERM** is the **RECV** bit stream and **ORIG** is the other.

6-10 HOW TO MEASURE A/B/C/D BIT TIMING (MENU OPTION 8)

Many times you want to measure the timing of the outgoing and incoming A and B bits (or C and D bits on ESF). Up to now, you had to haul out a strip chart recorder or something like that. The 930A gives you the capability to measure these bits down to 1 millisecond accuracy. Menu Option 8: **SUPERVISION MONITOR** is described in detail in Section 3-10.6. A brief recap starting from connecting up the 930A to the span will be helpful. To begin, this feature is most useful when you can look in both directions. This means that it is nice to have Option 930A-09E. Then you can connect the 930A to monitor both directions as shown on the following page.



The 930A should be set to 100 ohms Impedance and placed in the MONITOR 1&2 mode.

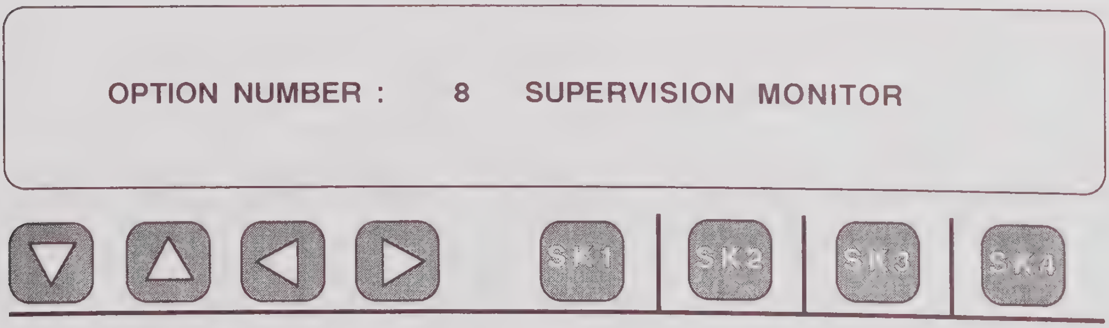
T-1 SUPERVISION EVENT TIMING WITH THE 930A
FIGURE 6-10

Set your 930A to the **MON-1&2** mode of the **PCM Trunk Type** as previously described in Section 6-3. **Next**, do the following.

Press the OPTION MENU ○ **Option Menu** function key.

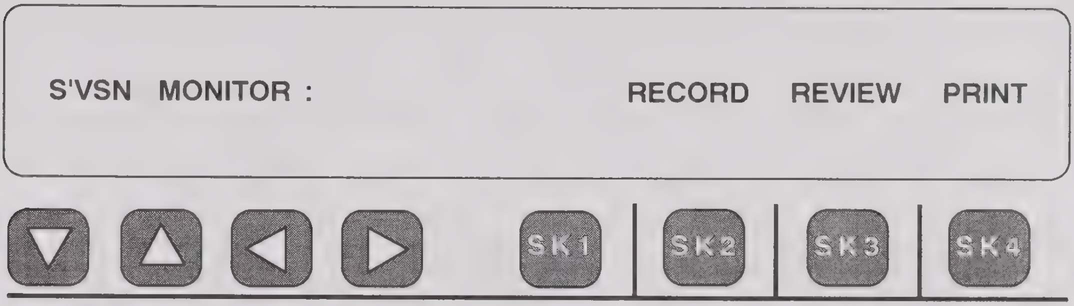
Use the UP/DOWN ▽ △ arrow keys to

get to Menu Option 8: SUPERVISION MONITOR.

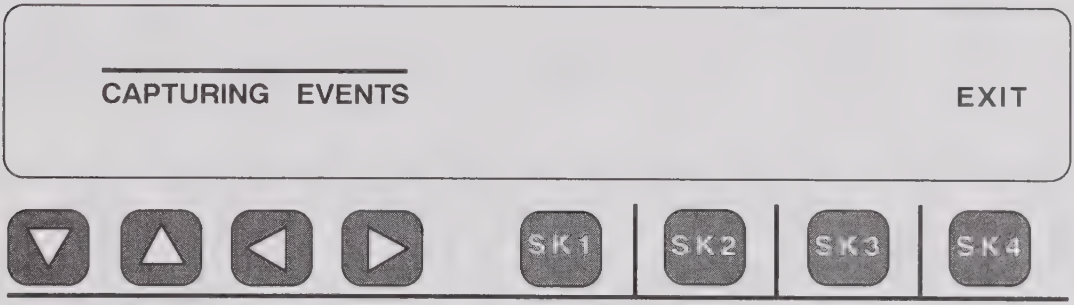


OPTION NUMBER : 8 SUPERVISION MONITOR

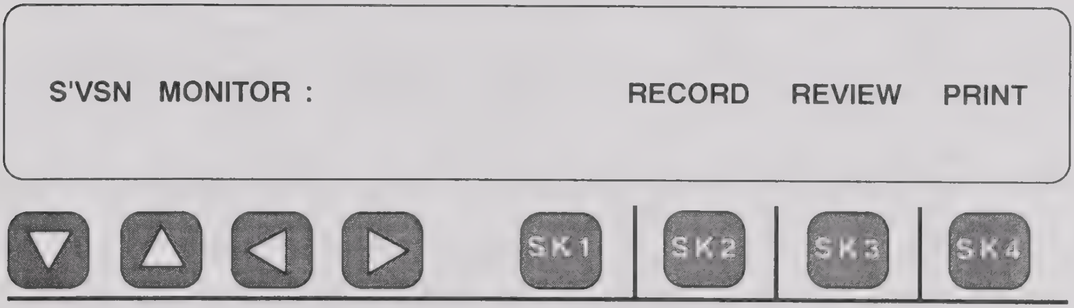
Press any softkey under the display to get to the main menu.



Whenever you want to start recording the supervision bits and their changes of state, press Softkey 2 (under **RECORD**) and the 930A will start recording and show you the screen below.

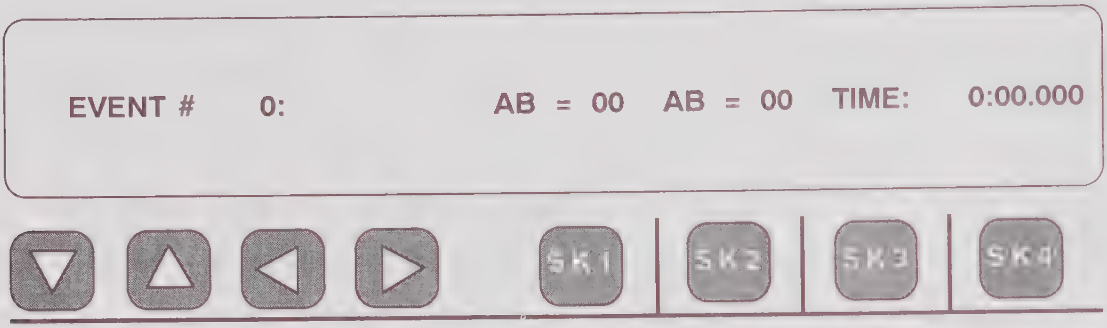


When you have recorded enough events (you can see the front panel supervision LEDs changing from On to Off Hook), press Softkey 4 (under **EXIT**) and you get back to the main menu.



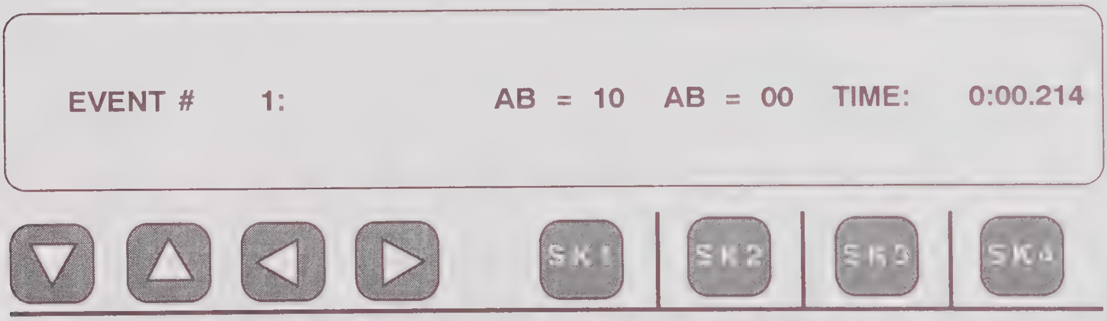
You can dump the buffer to a printer, if you have that option, or you can review the results one at a time. You can tell, for example, which end of a circuit is dropping calls, when, and which bit is at fault.

To review the results, press Softkey 3 (under **REVIEW**) and the first event will be shown.

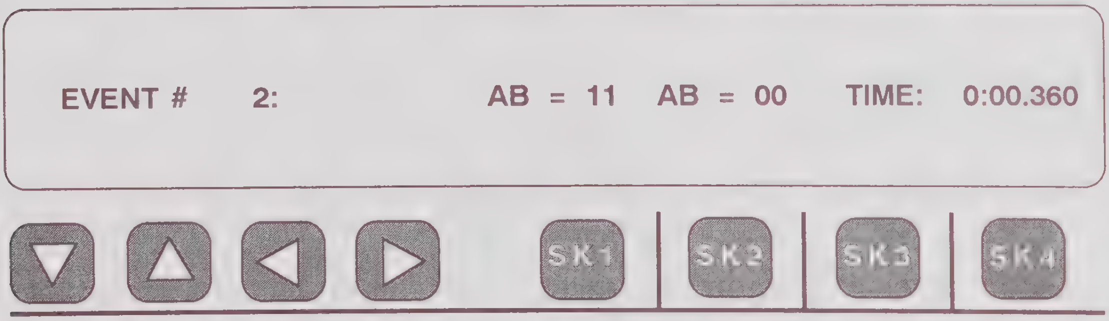


EVENT # 0: AB = 00 AB = 00 TIME: 0:00.000

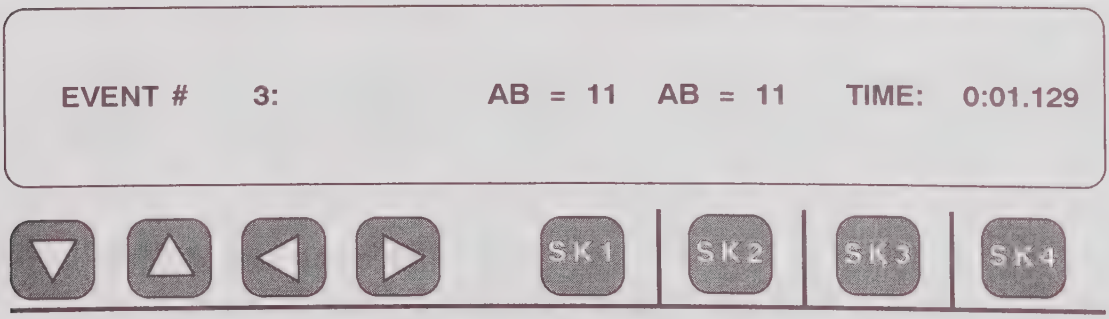
This is usually an **ON HOOK** state as shown above. Then you press the **UP** Arrow key to go up through the results. Example displays are shown below:



EVENT # 1: AB = 10 AB = 00 TIME: 0:00.214



EVENT # 2: AB = 11 AB = 00 TIME: 0:00.360

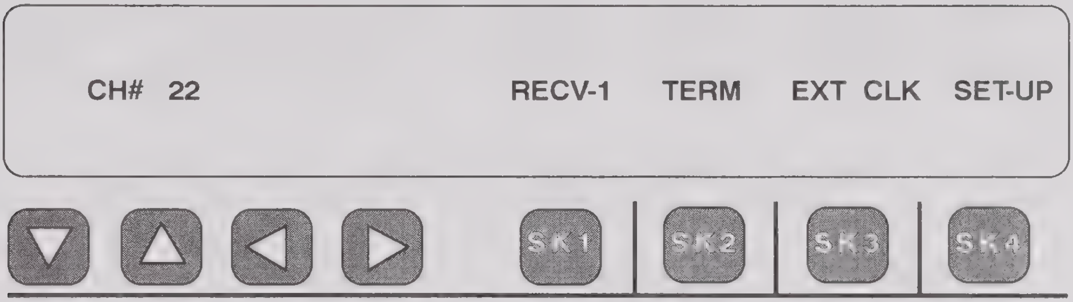


EVENT # 3: AB = 11 AB = 11 TIME: 0:01.129

6-11 HOW TO DEFINE YOUR OWN ON/OFF HOOK STATES

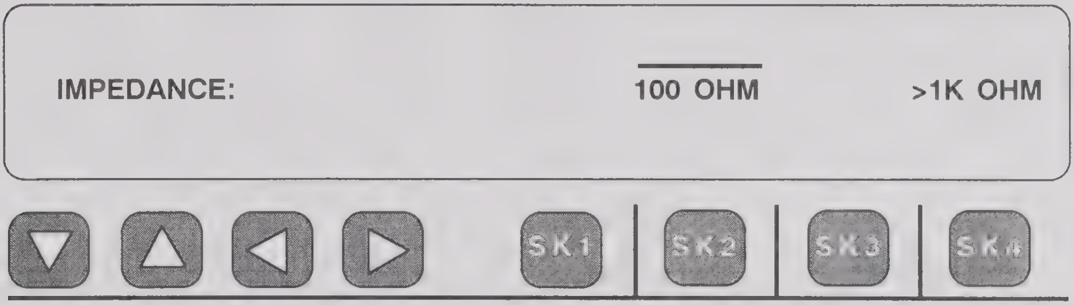
If you absolutely must, the 930A will allow you the flexibility to define your own **ON** and **OFF HOOK** states of the A/B/C/D bits. The **NORMAL** supervision default is the most useful, followed by **FXS/FXO** supervision. You can redefine what the 930A sends and recognizes as an **ON** or **OFF HOOK**. **This is not usually necessary.**

To redefine what the Hook Switch sends, instead of the default conditions, start at the main PCM display. An example follows.



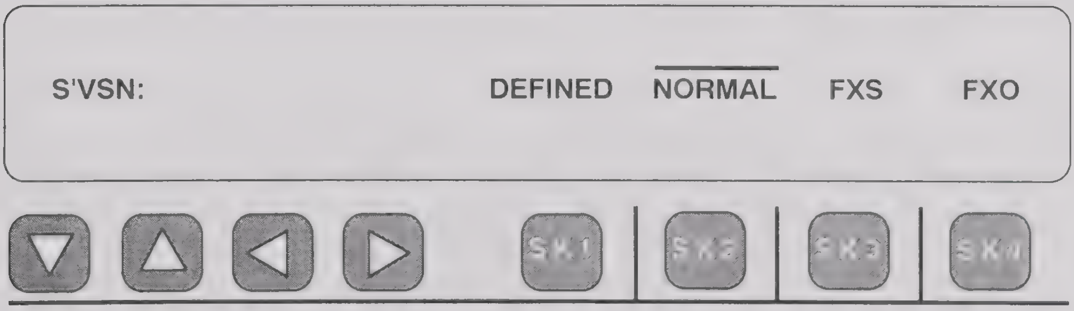
CH# 22 RECV-1 TERM EXT CLK SET-UP

Press Softkey 4 (under **SET-UP**) and the first set-up menu you see will be:

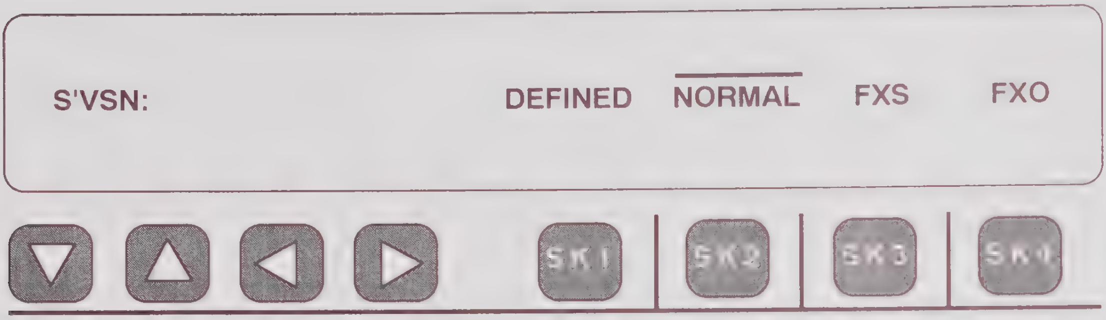


IMPEDANCE: 100 OHM >1K OHM

To get to the SUPERVISION set-up, press the **UP** Arrow key to page up through the set-ups to the following:

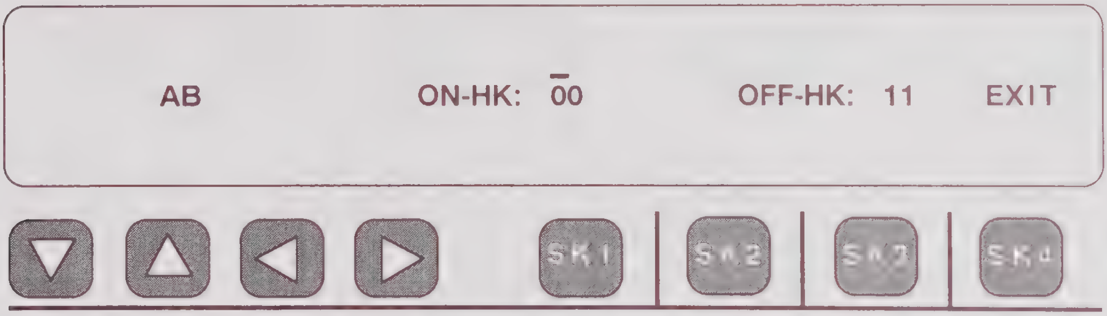


S'VSN: DEFINED NORMAL FXS FXO

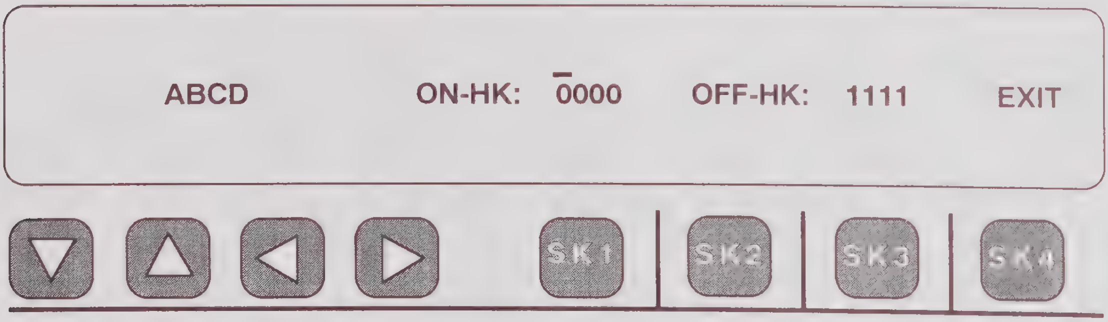


Note that the cursor is presently over **NORMAL** which is the default. **To define your own states**, press Softkey 1 (under **DEFINED**). Depending on whether you were in **D4 Superframe** or **ESF**, one of the following displays will appear:

D4/SF

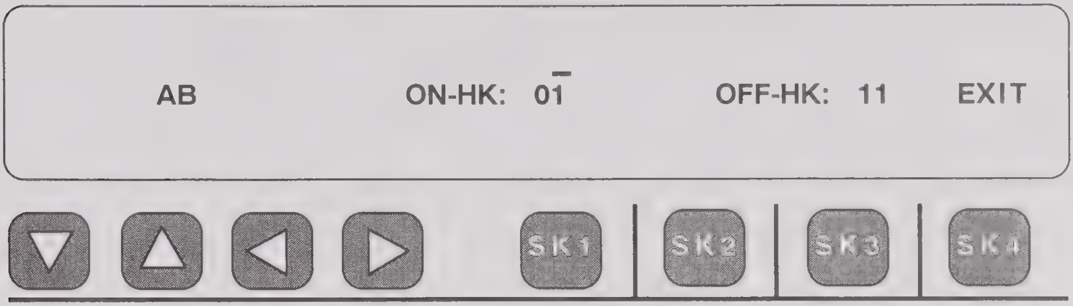


ESF



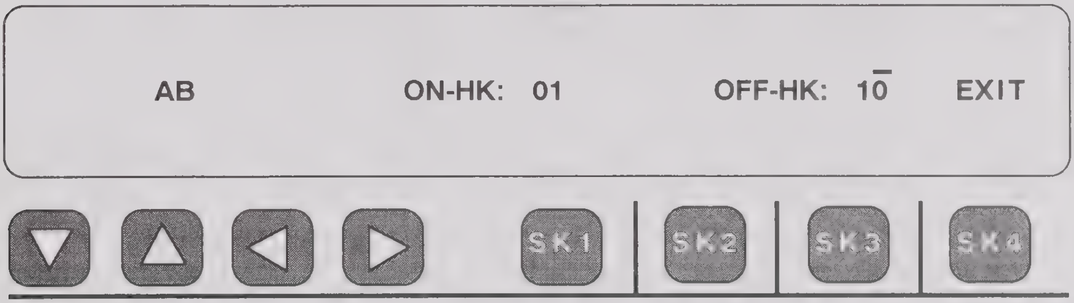
Note the cursor over the A bit position of the ON HOOK state. You can change the state of the **ON HOOK** A, B, C or D bits by moving the cursor over the bit you want to change with the **LEFT/RIGHT** Arrow keys and then entering a 1 or a 0 from the keypad. You can also change states using the **UP/DOWN** Arrow keys. You change the **OFF HOOK** states by pressing Softkey 3 and the cursor will move over to the **OFF HOOK** side.

Suppose you were on a D4 Superframe span and you wanted an **ON HOOK** to be 01, instead of 00, and an **OFF HOOK** to be 10, instead of 11. You would move the cursor over the B bit position and enter a 1 from the keypad so the display looked like:



AB ON-HK: 01 OFF-HK: 11 EXIT

Next, you would press Softkey 3, use the **Right** Arrow key to move the cursor over the **OFF-HK** B bit, and enter a **0**. The display would look like:



AB ON-HK: 01 OFF-HK: 10 EXIT

Now you could return to the main menu by pressing Softkey 4. **Now when you** go **OFF HOOK** using the front panel Hook Switch, the 930A will send 10 instead of 11. Likewise, the **ON HOOK** will be 01 instead of 00.

When the 930A detects the **OFF HOOK** bit pattern, the Off Hook LED on the front panel lights. When the **ON HOOK** bit pattern is detected, the On Hook LED lights. If neither bit pattern is detected, no LEDs light. If the supervision LEDs on your front panel are not lit, the supervision bit patterns are not correctly defined.

Remember to reset the 930A back to NORMAL when you are finished testing in the DEFINED mode. You will have problems drawing dial tone and getting the Supervision LED's to read properly on a regular PCM channel if you do not.

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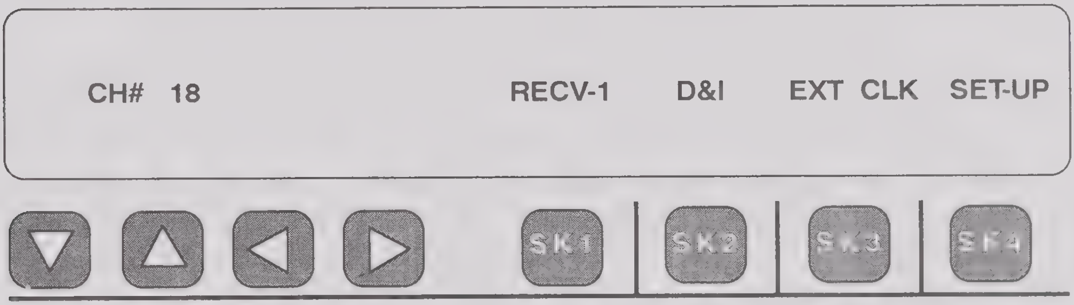
6-12 HOW TO SELECT FOREIGN EXCHANGE SUPERVISION

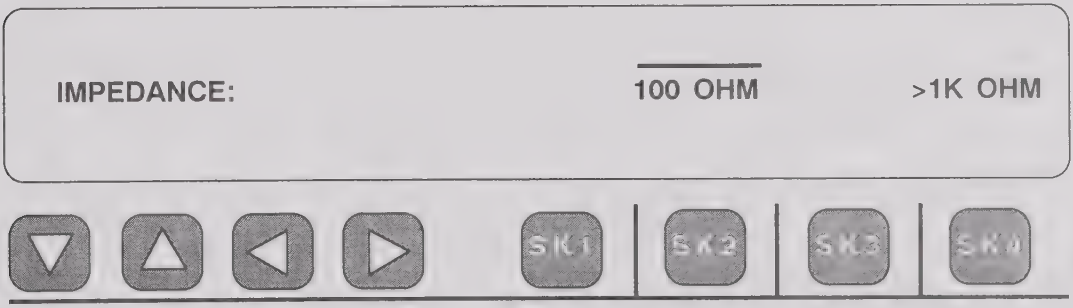
You must purchase **Option 930A-25 (FXO/FXS Supervision)** to operate on Foreign Exchange circuits on **PCM** Trunks. The option appears under the **PCM SET-UP** menu for supervision.

To select FX supervision follow these steps:

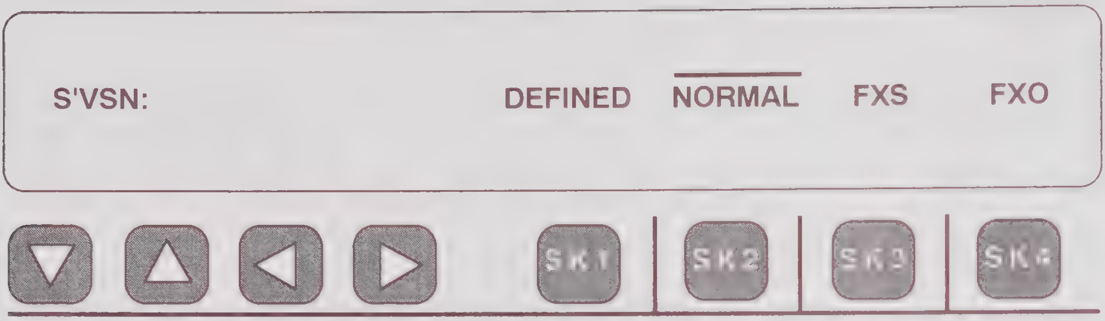
First, start from the main PCM display. An example of the display for the **D&I** mode follows.



Next, press Softkey 4 (under **SET-UP**) to get into the set-up menus, starting at **IMPEDANCE**.



Use the **UP** Arrow key to page up to the **SUPERVISION** display shown on the next page.



You need to know is whether you want the 930A to be the Foreign Exchange Office (**FXO**) end or Station (**FXS**) end of the circuit. A brief description of them, when in **D4 Superframe** mode, follows to assist you.

In Foreign Exchange Station (**FXS**) mode, when the 930A is On Hook, it sends the Loop Idle bit pattern (A=0, B=1). When the 930A is Off Hook, it sends the Ground-on-Ring bit pattern (A=0, B=0) until the far end Foreign Exchange Office (**FXO**) returns Ground-on-Tip (A=0). The 930A will then send the Loop Closed bit pattern (A=1, B=1). This mode works equally well with Loop Start and Ground Start offices.

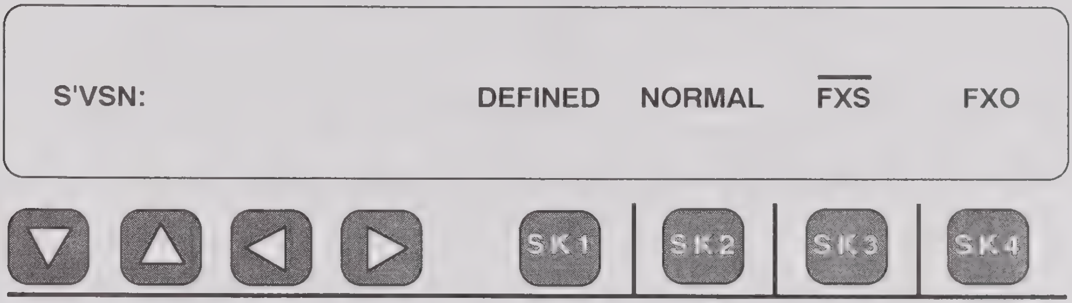
The 930A assumes that the far end is sending **FXO** supervision and interprets A=0 to mean Tip Ground (**Off Hook**), and A=1 to mean No Tip Ground (**On Hook**). B=0 is interpreted as Ringing, and B=1 is interpreted as No Ringing.

In Foreign Exchange Office (**FXO**) mode, when the 930A is On Hook, it will send the No Ground-on-Tip bit pattern (A=1, B=1). When the 930A is Off Hook, it will send the Ground-on-Tip bit pattern (A=0, B=1).

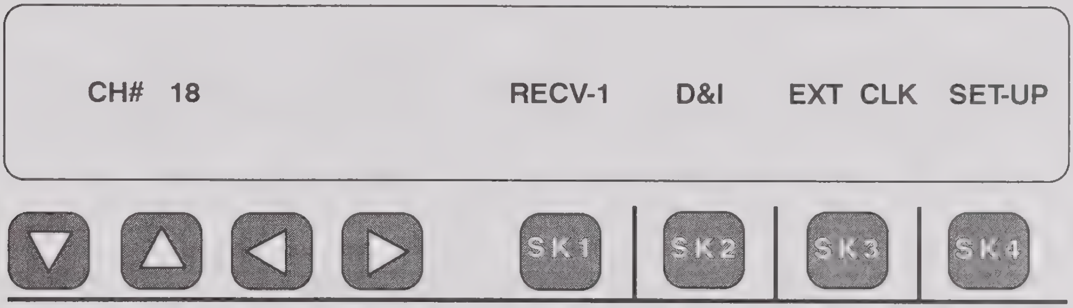
The 930A leaves the B bit set (B=1) to indicate No Ringing. You can send Ringing to the far end by entering Menu Option 21: **TOGGLE A\B BITS**, and setting the B bit to zero manually. The B bit will revert to a 1 when the user exits the **TOGGLE A\B BITS** menu option.

The 930A assumes that the far end is sending **FXS** supervision and interprets either Ring Ground (A=0, B=0) or Loop Closed (A=1, B=1) as an Off-Hook. This enables the 930A to operate with either Loop Start or Ground Start **FXS** equipment. The 930A interprets Loop Idle (A=0, B=1) as an On Hook. The unused bit pattern (A=1, B=0) is also interpreted as an On Hook.

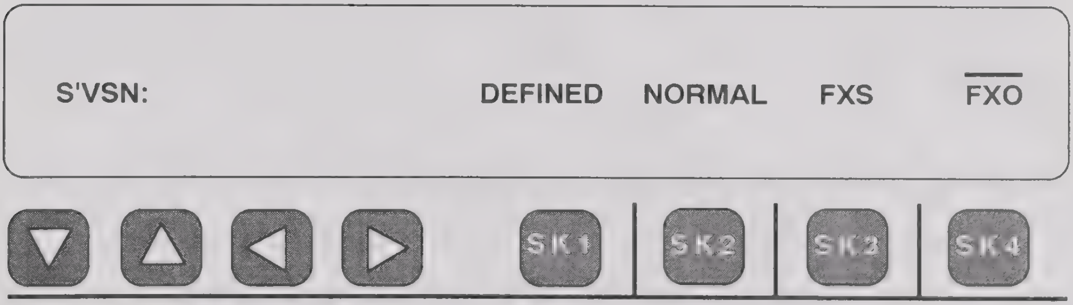
To select FXS (PBX or Station end) supervision, press Softkey 3 (under **FXS**) and the display will momentarily show your choice as:



It will return to the main **PCM** display below.



To select FXO (or Central Office end) supervision, press Softkey 4 (under **FXO**) and the set-up display will momentarily show your choice as:

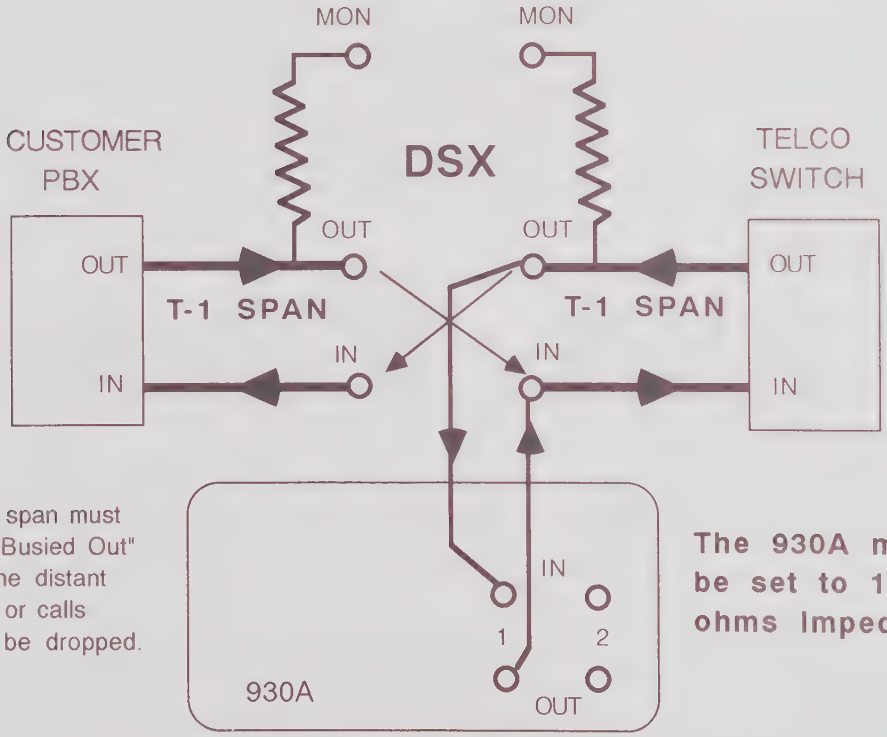


In either case, the front panel Hook Switch will now follow the type of Foreign Exchange supervision you selected. **Remember to reset your supervision to NORMAL when you are finished testing in FXS/FXO so that you can operate on regular PCM channels.**

6-13 HOW TO SEND PCM ALARMS AND FORCE FRAME SLIPS (MENU OPTION 40)

Sending Remote Alarm, Blue Alarm or forcing a Frame Slip is obviously not intended to be done on spans carrying service. They are tests usually performed prior to turning up service on a channel bank or switch to see that their alarm indicators are working. **The 930A will not allow you to send alarms or slips unless you are in the TERMINATE mode (out of service).**

You connect your 930A as shown below and set it into the **TERMINATE** mode.



NOTE: The span must be "Busied Out" at the distant end or calls will be dropped.

The 930A must be set to 100 ohms Impedance

PCM MODE: TERMINATE

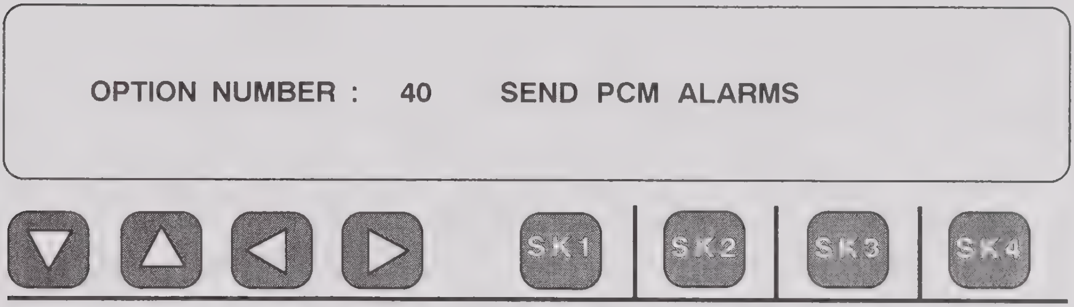
SENDING ALARMS OR FORCING SLIPS FROM THE 930A
FIGURE 6-11

You may try to force a frame slip toward the distant end of your circuit to see if it is loop-timed. If it is loop-timed, you will not be able to force a slip toward it. You may want to send Remote (or Yellow) Alarm toward a channel bank to see what it does, or you could send the Blue Alarm (all 1's). These are useful tests, but not when you have service on a span.

To send alarms, or force slips, do the following:

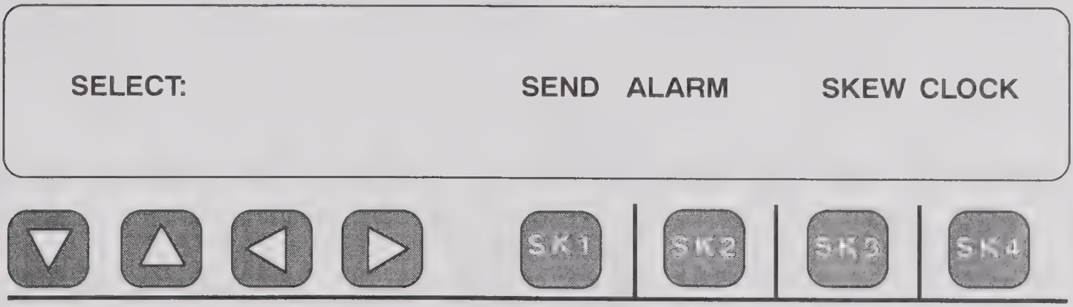
Press the OPTION MENU ○ Option Menu function key.

Use the UP/DOWN ▽ △ arrow keys to get to Menu Option 40: SEND PCM ALARMS.



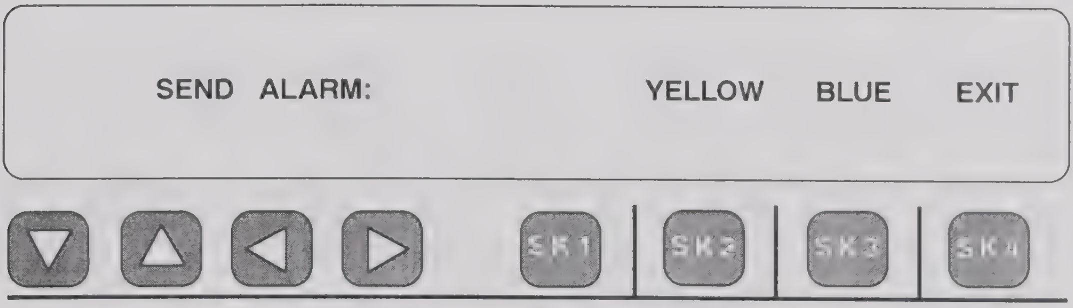
OPTION NUMBER : 40 SEND PCM ALARMS

Press any softkey under the display to get into the main menu.

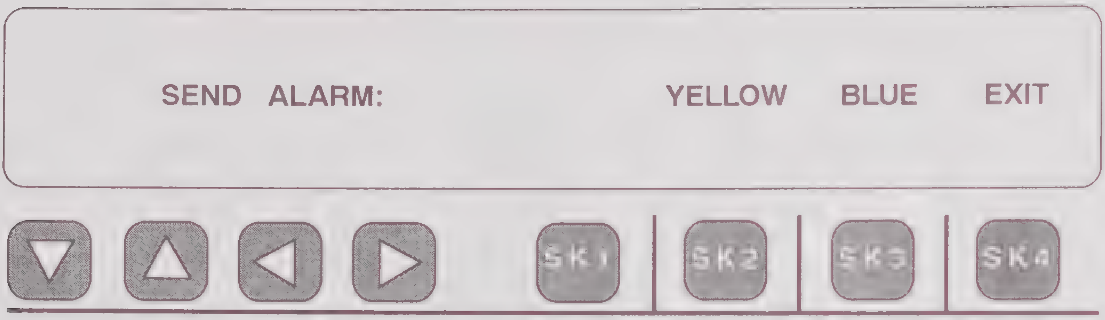


SELECT: SEND ALARM SKEW CLOCK

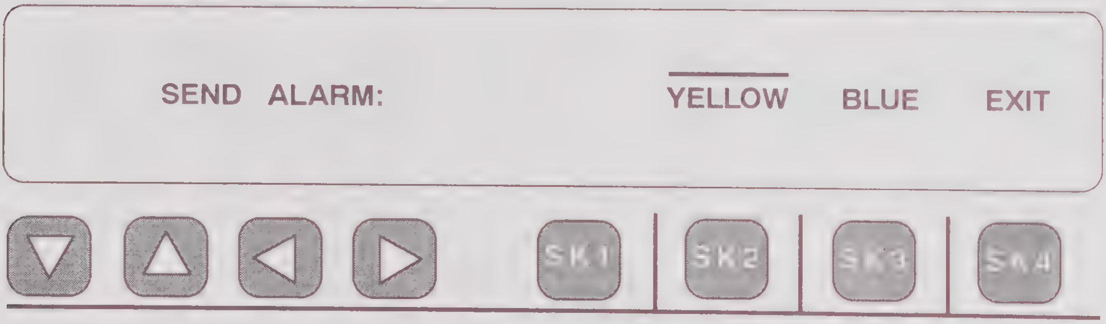
To send an Alarm, press Softkey 1 or 2 and the Alarm display will appear.



SEND ALARM: YELLOW BLUE EXIT

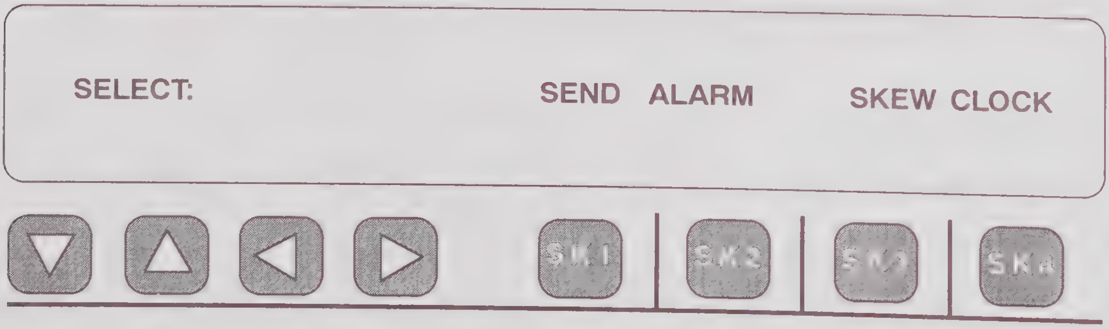


Press Softkey 2 to send the Remote, (Yellow) Alarm (on D4 and SLC-96, bit number 2 is forced to 0 on all 24 channels; on ESF, a special code is sent over the Facility Data Link). Press Softkey 3 to send the Blue Alarm (All 1 s). When you select an alarm, a cursor appears over your selection as shown below for the example of a Yellow Alarm:



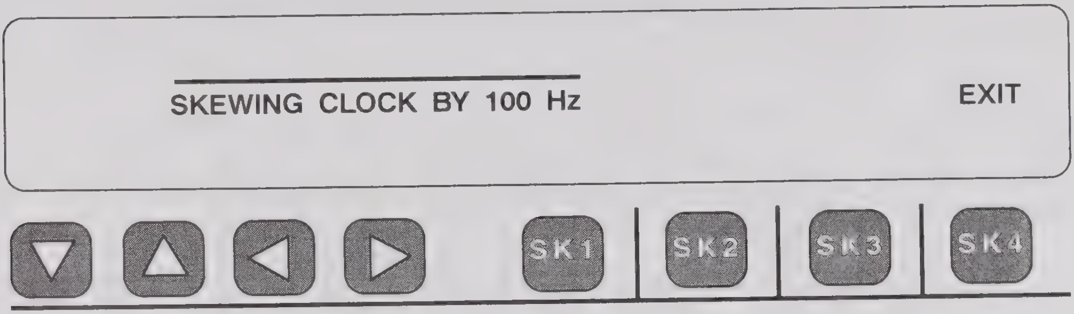
When you exit from this menu the alarm is turned off.

To force a slip, the 930A must be supplying the clock to the circuit (INT CLK) and then you can offset or skew the clock.



Press Softkey 3 or 4; if the 930A is set to Internal Clock the normal 1.544 MHz clock will be offset by 100 Hz. **This is enough to force frame slips to occur if the distant end of the circuit is not Loop-Timed.**

While you are skewing the clock, the display will look like:



When you exit the menu, you return to the normal clock. Slips, if they occur will be detected while you are in this menu and the display will be interrupted momentarily to indicate slips are occurring. The Slip Counter in Menu Option 43 will also be counting the slips.

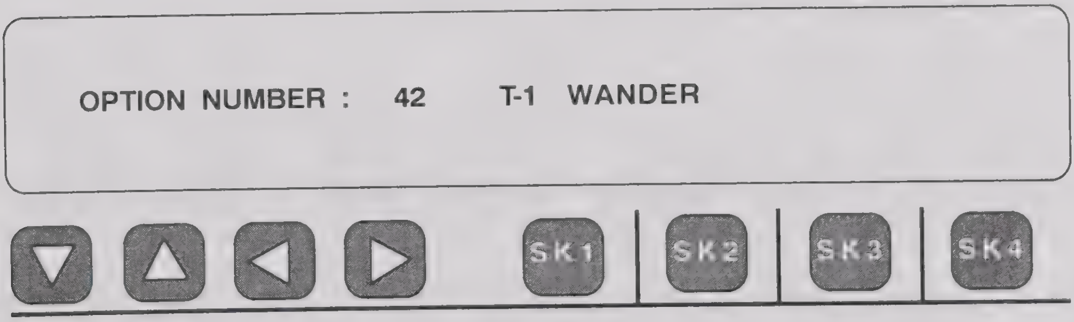
6-14 HOW TO DETECT T-1 WANDER OR CLOCK DIFFERENCE (MENU OPTION 42)

T-1 Wander, sometimes called Bit Slips, is what you have prior to a Frame Slip. You can use Menu Option 42: **T-1 WANDER** to get an indication of whether or not a span may have a slip problem. This Menu Option is best used with the 930A in the **MON-1&2** mode so you can compare the outgoing and incoming clocks. **After you set-up the PCM Trunk Type**, do the following:

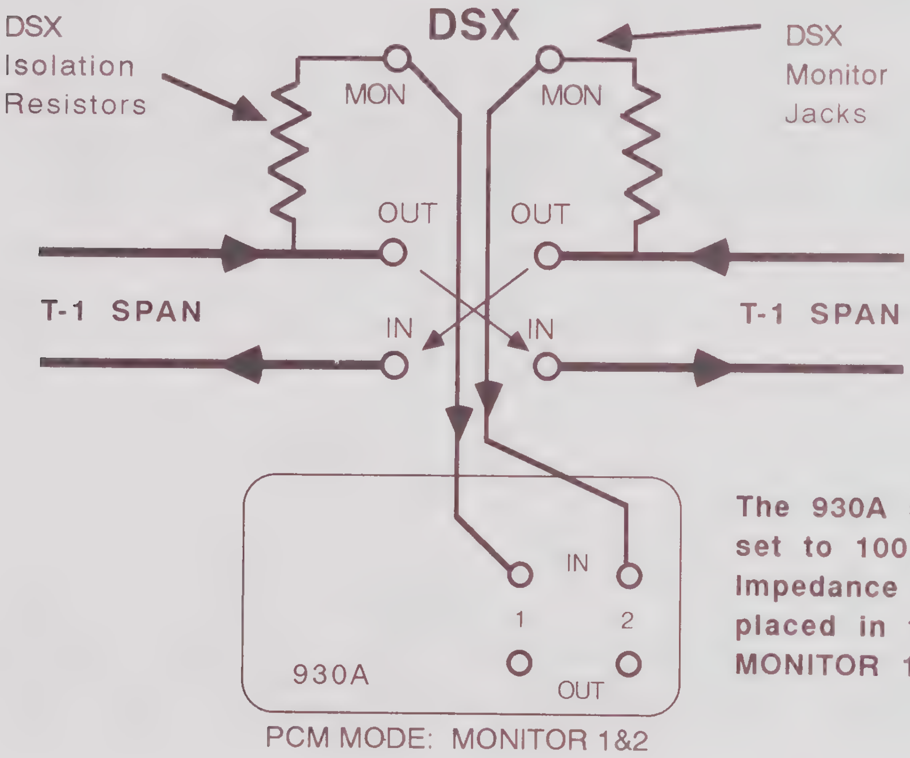
Press the OPTION MENU ■ ○ **Option Menu** function key.

Use the UP/DOWN ▽ △ arrow keys to

get to Menu Option 42: T-1 WANDER.



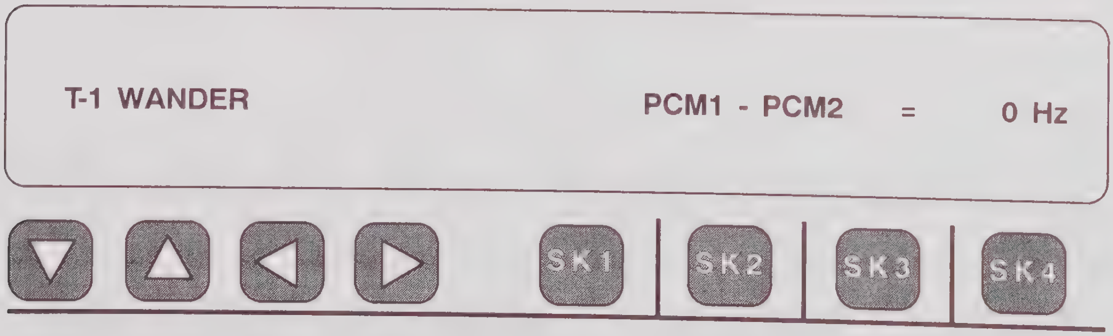
Press any softkey under the display and the 930A starts measuring. If you have the 930A connected as shown below, you will compare the clock on the two sides of the span.



The 930A should be set to 100 ohms Impedance and placed in the MONITOR 1&2 mode.

930A CONNECTED FOR WANDER MEASUREMENT
FIGURE 6-12

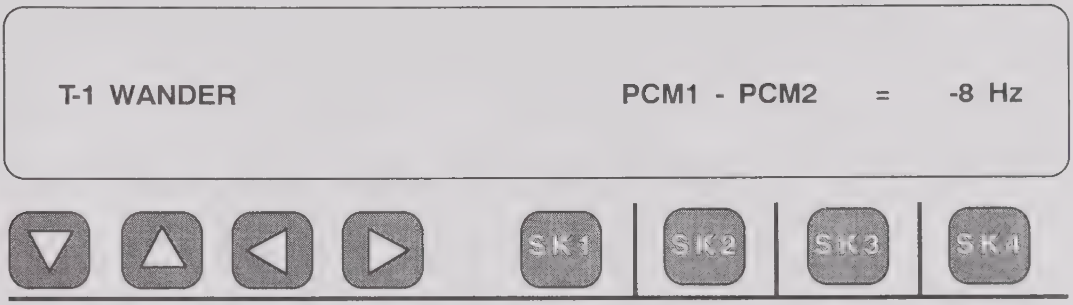
If you are Loop-Timed, and your clock is good, the display will be:



```
T-1 WANDER                    PCM1 - PCM2   =    0 Hz
```

This frequency difference between bit streams is also called the Bit-Slip rate (gated rate for 1 second). 192 Bit-Slips = 1 Frame Slip.

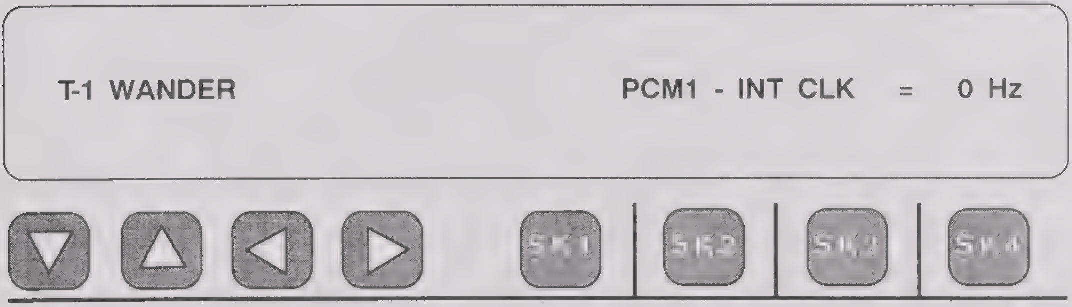
If you are not Loop-Timed, you might see a display like:



In this case, bit slips will occur and the two sides may diverge until a frame slip occurs. This could be in either the + or - direction. The result will be the same because bit slips will start to occur. If you connect the 930A's **PCM IN 1** jack to a known good clock, then you can connect **PCM IN 2** to the suspect side of the span and see if it is different. You should stay connected to the **DSX Monitor** jacks.

You can also use this Menu Option with the 930A in the **MON-1** or **TERMINATE** modes. In this case the 930A compares the clock on **PCM IN 1** to its own Internal Clock. **Be aware that if you are in the TERMINATE mode and on EXT CLK (Loop Timed), going to this Menu Option will cause the 930A to temporarily change to INTERNAL CLOCK. When you EXIT from this menu, the 930A returns to EXT CLK.**

A typical display of wander, when you are in a single direction mode is:



Do not expect PCM1 to agree with the 930A **Internal Clock**, unless the far-end is **Loop Timed** to the 930A. The actual value is not very significant. Large changes in the readings, however, indicate that the clock in your switch, or the clock in your 930A, is wandering and needs to be repaired.

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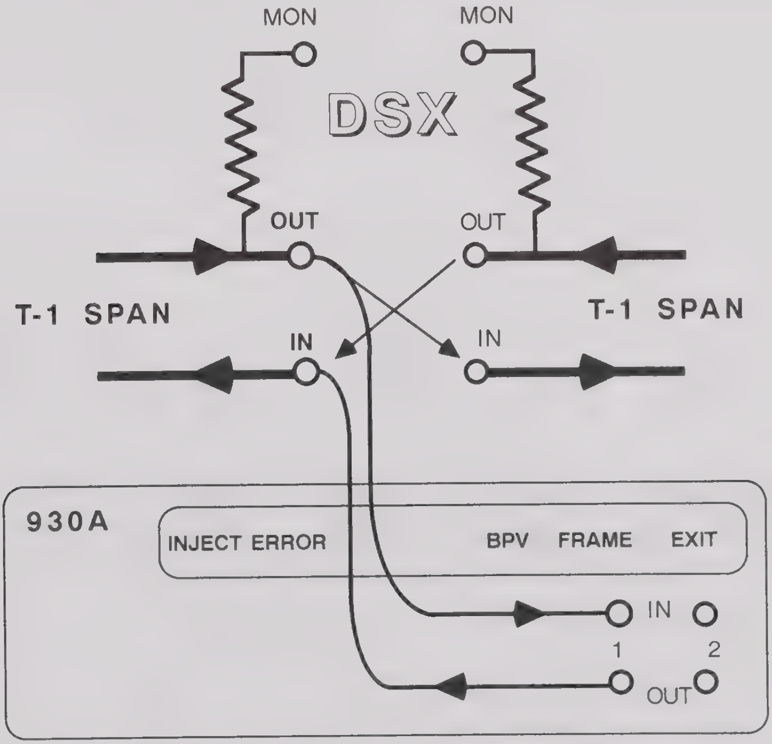
6-15 HOW TO INJECT A BPV OR FRAME ERROR (MENU OPTION 45)

There are times when you want to inject a Bipolar Violation or Frame Error (or CRC Error in Extended Superframe) toward the distant end, or on a loopback, to check integrity.

As part of Option 930A-08E or -09E, the 930A gives you the capability to inject a single BPV, Frame Error or CRC Error. This feature is only active when the 930A Trunk Type has been set to either the **TERMINATE** or **D&I** mode. Errors cannot be injected when the 930A is monitoring the T-1 facility.

A typical connection of the 930A when operating in the **TERMINATE** mode (simulating a channel bank) is shown below.

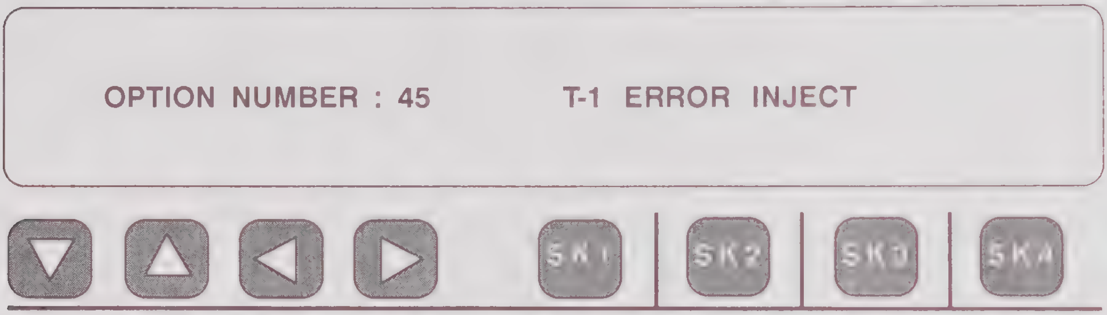


INJECTING ERRORS WITH THE 930A
FIGURE 6-13

To access the **INJECT ERROR** feature, just follow the procedure outlined on the next page.

Press the OPTION MENU ○ Option Menu function key.

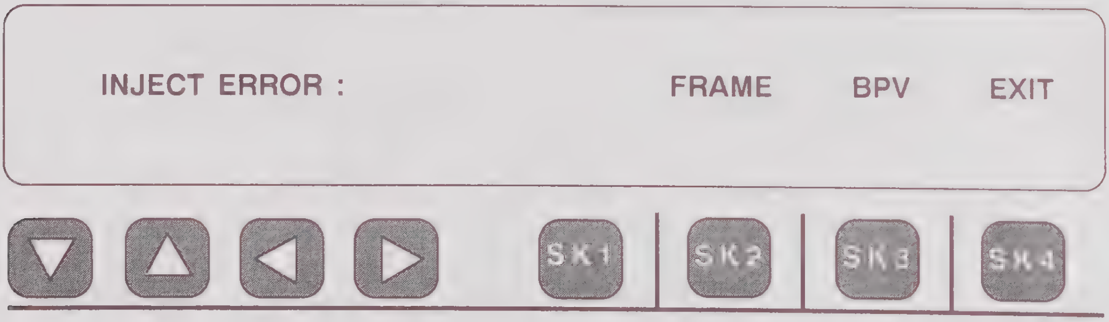
Use the UP/DOWN ▽ △ arrow keys to get to Menu Option 45: T-1 ERROR INJECT.



OPTION NUMBER : 45 T-1 ERROR INJECT

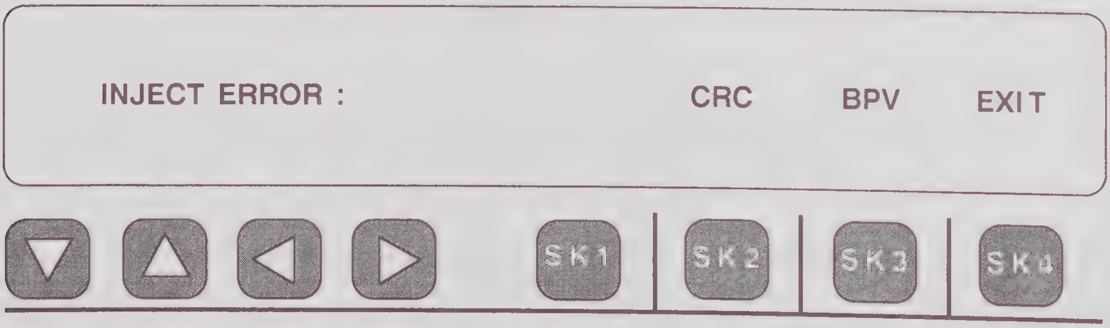
Press any of the softkeys under the display to enter the Menu Option and the display which appears will depend upon whether the 930A has been set for D4 Superframe or the new Extended Superframe (ESF) operation. The displays are shown below.

For D4 Superframe, the **INJECT ERROR** display appears as:



INJECT ERROR : FRAME BPV EXIT

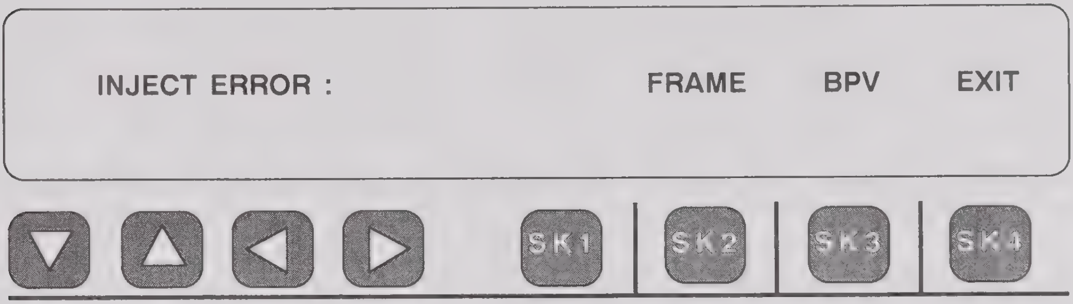
For Extended Superframe, the display appears as:



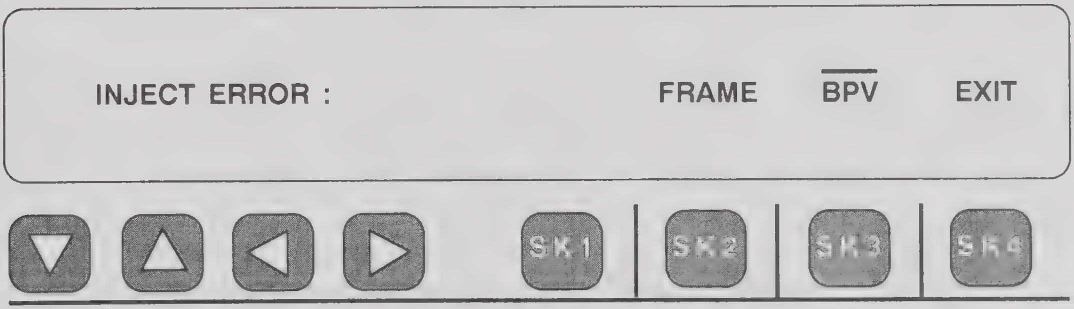
INJECT ERROR : CRC BPV EXIT

The operation is the same, except that CRC Errors are substituted for Frame Errors when the 930A is operating on an ESF span.

To inject an error, all you have to do is press the softkey directly beneath the type of error you want the 930A to send. For example, to send a Bipolar Violation (BPV) on the T-1 facility, press Softkey 3 under BPV.



The display will momentarily flash a cursor over BPV,

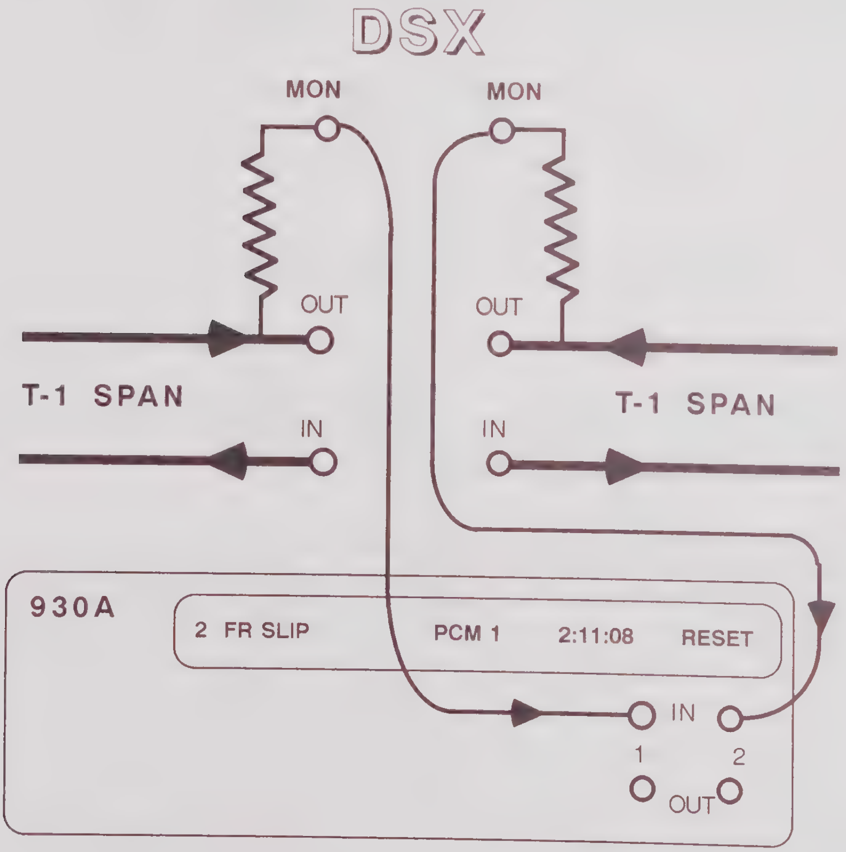


and the error will be sent. The procedure is exactly the same when you want to send a Frame Error or a CRC Error. If you are testing on a looped back facility, the 930A will record the error coming back. The display would flash "Bipolar Violation" and the BPV counter in Menu Option 43 would increment.

6-16 T-1 ERROR HISTORY (MENU OPTION 44)

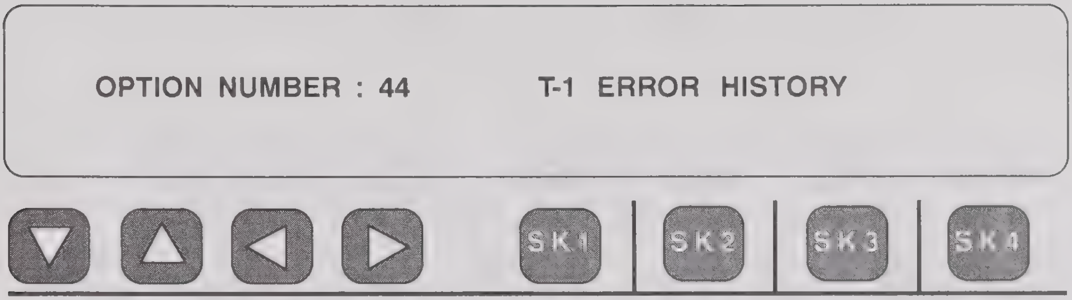
With Option 930A-08E or -09E, you also get Menu Option 44: **T-1 ERROR HISTORY**. This feature gives you up to 24 hours of history on the span under test. Error counts of Frame Slips, Bipolar Violations, Frame Errors, (CRC Errors on ESF), Frame Losses, Bit Slips (Wander), and Losses of PCM are recorded. Counts are displayed in 15 minute blocks for up to 24 hours at a time. If the 930A is connected to a printer (or a computer), the information is not limited to the last 24 hours.

As an example, suppose you have set up your 930A to monitor both directions of transmission, as shown below (the 930A PCM Trunk Type has to be set to **MON 1&2** mode as outlined in section 6-3, page 6-15).

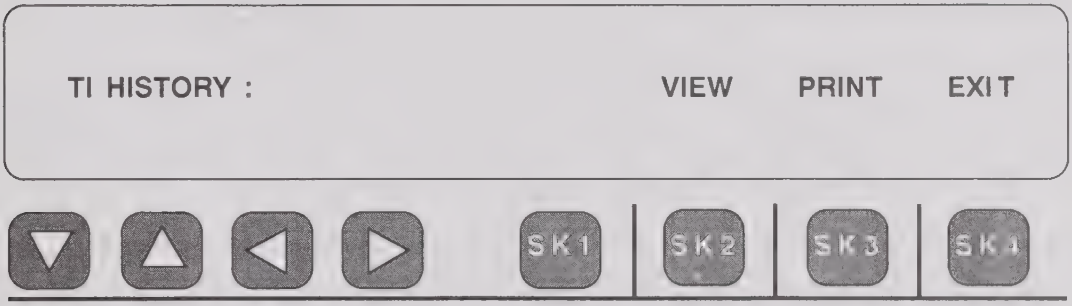


You go home, come back to work the next morning, and decide to see what went on overnight. Press the **OPTION MENU** function key and use the UP/DOWN arrow keys to get to Menu Option 44 or enter the number 44 on the keypad and press the **ENT** (Enter) key.

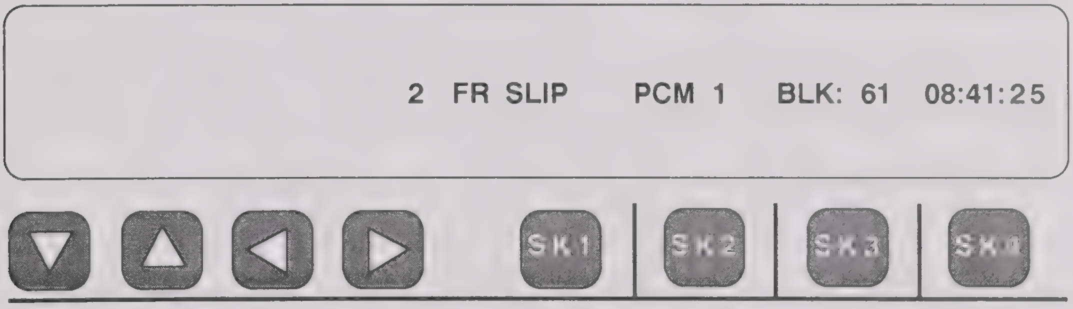
Once you are at Menu Option 44,


OPTION NUMBER : 44 T-1 ERROR HISTORY

you enter it by pressing any of the softkeys under the display. The main display looks like:

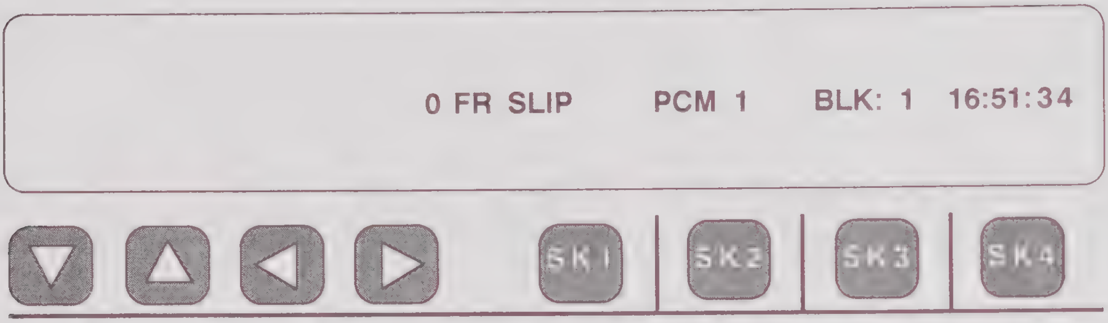

TI HISTORY : VIEW PRINT EXIT

To review the errors which have occurred over the past 24 hours, just press Softkey 2 under **VIEW** and the history display will come up showing the latest block it is accumulating error data in. An example might look like:


2 FR SLIP PCM 1 BLK: 61 08:41:25

This is the sixty-first 15 minute block of time since the test began so this is roughly 15 hours later (the current time is 8:41:25 AM). To find out what has gone on over this time period, press Softkey 3 under **BLK: 61** and the

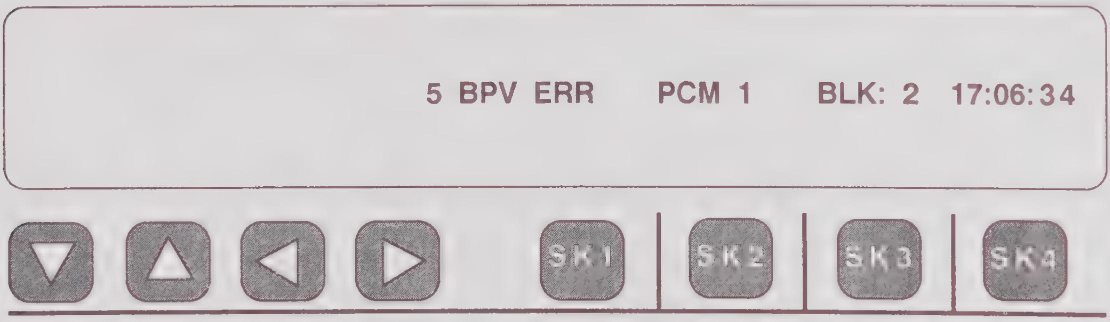
930A display will roll back to Block 1. For example purposes, the **BLK: 1** display is:



```
0 FR SLIP    PCM 1    BLK: 1   16:51:34
```

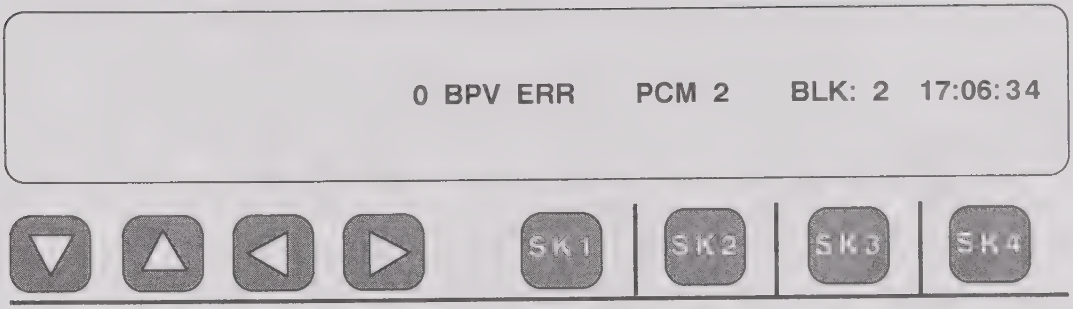
This indicates that the testing began at 4:51:34 PM. By pressing Softkey 1, you could scroll through the parameters. Similarly, by pressing Softkey 3 you could scroll through the blocks. This is useful because there may be a specific time period in which the errors occurred. There may be no errors in the other blocks. Of course, with up to 96 blocks this can be a bit tedious. You can spare yourself this dubious pleasure by connecting a printer or computer to the 930A (if you purchased option 930A-10C).

Since the 930A was monitoring both sides of the line in this example, you get the history of PCM 2 as well. To view this data, press Softkey 2 under **PCM 1** to toggle between sides. Suppose we were looking at BPVs on PCM 1:



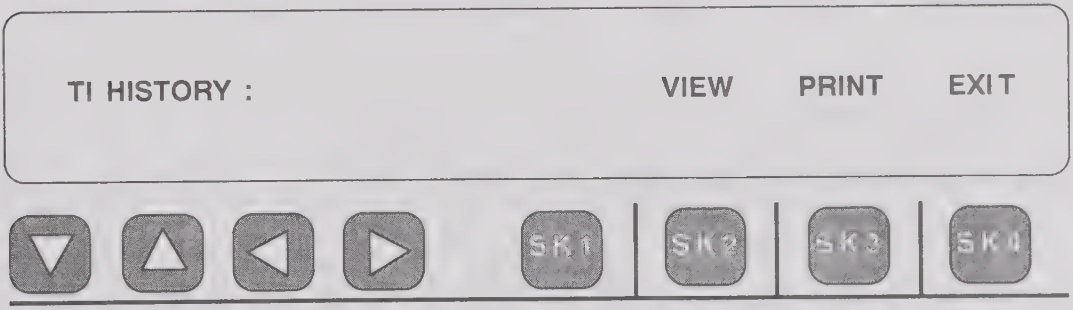
```
5 BPV ERR    PCM 1    BLK: 2   17:06:34
```

This shows 5 errors occurred during Block 2 coming into PCM 1 input. Pressing Softkey 2 will show us what came into PCM 2 in that same period. An example display is shown on the next page.

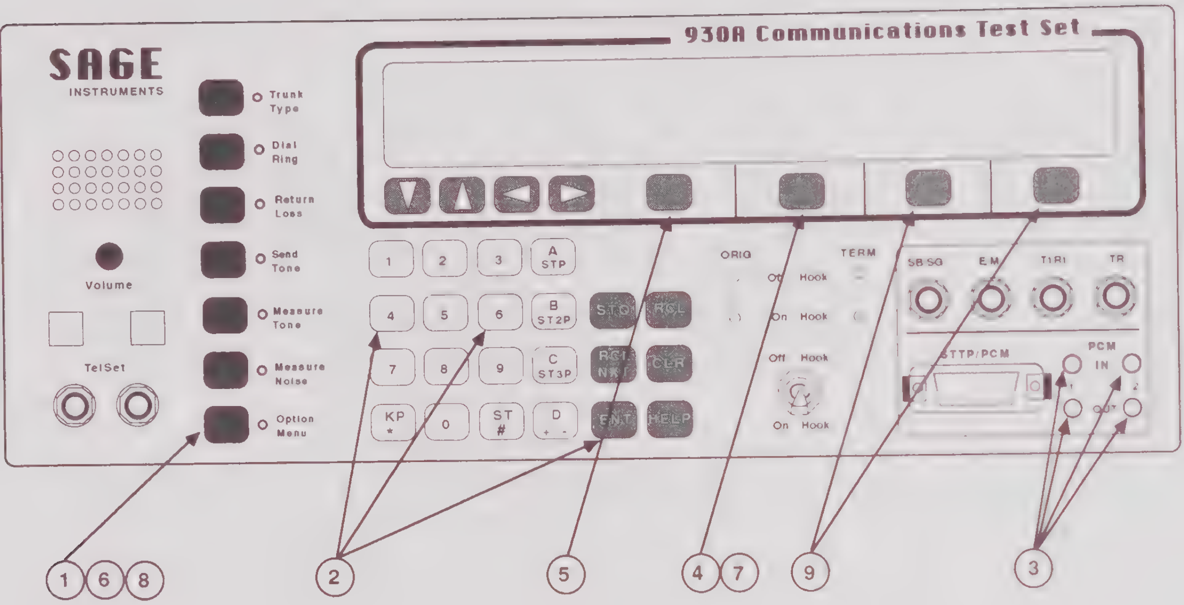


In this example, we see that there were no errors coming into side 2 in that time frame. This points the finger toward whatever is connected to side 1 as the source of the problem.

To return to the main menu, press the **OPTION MENU** key and the display will become:



To print out the results to date, press Softkey 3 under **PRINT** and the results of the testing for both sides will be printed out starting at Block 1 if you have connected a printer to the 930A. If the 930A is already in Printer remote (see Section V) and a printer has been connected during the test, the results will be printed out automatically as Blocks are incremented (every 15 minutes) without having to press Softkey 3.



To select and use **DS-1 Bit Error Rate Testing (BERT)**:

1. Press the **OPTION MENU** function key.
2. Enter the number **46** on the numeric keypad and press the **ENT** (Enter) key.
3. Connect Test Cords for either single or dual-direction **BERT** as shown in Figures 6-15 and 6-16.
4. Press Softkey 2 under **TEST** to begin testing with the default settings, or skip this step to change defaults.

To check or change the default settings or patterns:

5. Press Softkey 1 under **SET-UP** in the main **SELECT** menu and use the softkeys to select and change default settings as required.
6. Press the **OPTION MENU** key to get back to the main menu.
7. Press Softkey 2 under **TEST** to begin testing.
8. Press the **OPTION MENU** key to return to the main menu.
9. Press Softkey 3 under **HISTORY** to review previous 24 hours test results, or press Softkey 4 under **EXIT** to stop testing.

DS-1 (T-1) BIT ERROR RATE TESTING
FIGURE 6-14

6-17 DS-1 BIT ERROR RATE TESTING WITH THE 930A (MENU OPTION 46)

If you have purchased Option 930A-22 for your 930A, you will find that Menu Option 46: **DS-1 BIT ERROR RATE (BER)** has been enabled. If you have Option 930A-08E then you have single direction BER testing capability. If you have Option 930A-09E then you have the equivalent of two BER test sets. Diagrams of test cord connections are provided in the following sections.

Every effort has been made to keep this feature simple and easy to use. For instance, **unlike other 930A functions, it is not necessary to set up the TRUNK TYPE to use Menu Option 46.** It does not matter what **TRUNK TYPE** the 930A was in previously. When you enter Menu Option 46 the 930A automatically sets itself to T-1 operation. The factory default parameter settings have been chosen to let you begin testing in most instances without changing any set-ups. As you will see from Figure 6-14 there are few steps required.

You will have to know how to connect test cords from the 930A to the T-1 under test (DSX or CSU jack access points). You will also have to know how to take the T-1 out of service prior to any testing. After that though, there are few steps necessary to test the span using the 930A. The following sections outline test cord connections, BER testing in various situations, and how to change the test parameters if you have to.

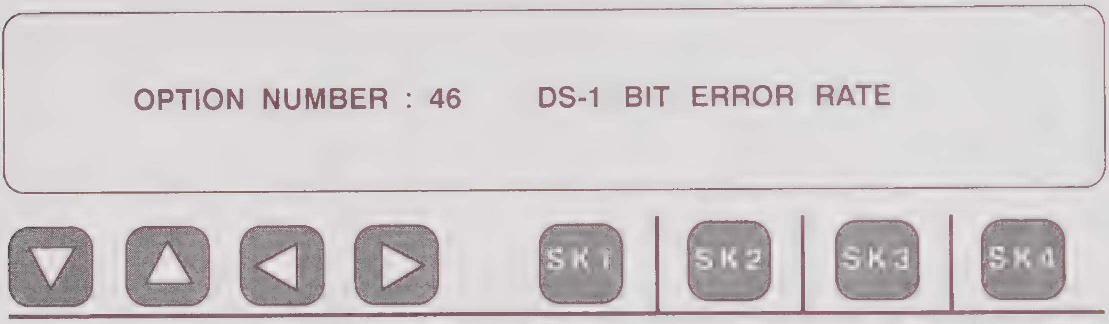
6-17.1 BIT ERROR TESTING USING THE 930A

When you want to do a **BER** test using the 930A, just do the following:

Press the OPTION MENU ○ **Option Menu** function key.

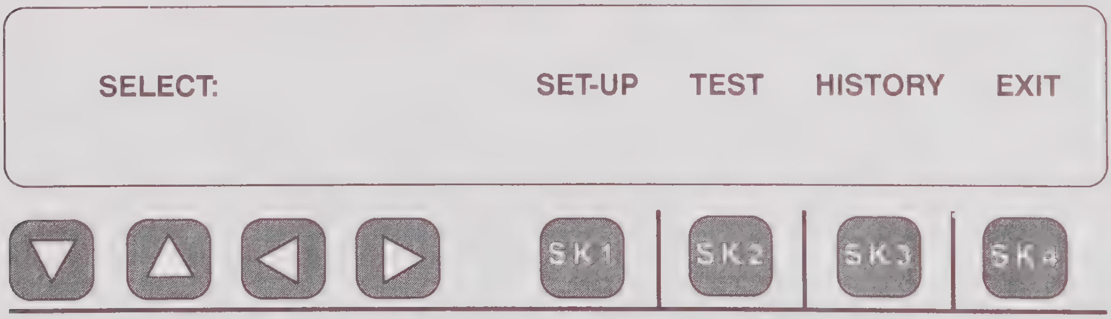
Use the UP/DOWN ▽ △ arrow keys to

get to Menu Option 46: DS-1 BIT ERROR RATE.

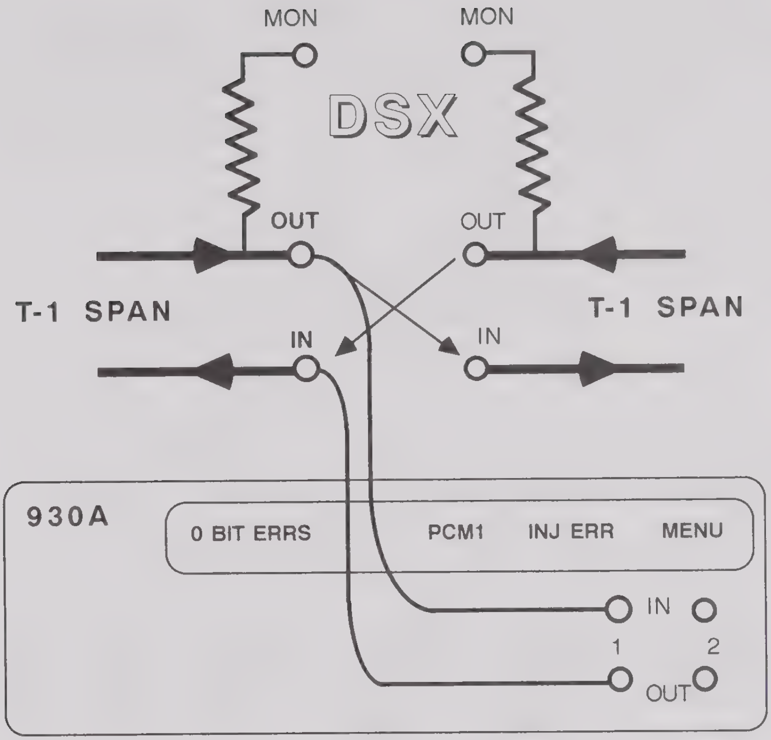


OPTION NUMBER : 46 DS-1 BIT ERROR RATE

Enter Menu Option 46 by pressing any of the softkeys under the display and the main selection menu will be displayed. You can also enter the number **46** from the keypad and then press the **ENT** (Enter) key. **The 930A sets itself to T-1 automatically.**



Connecting the test cords from the 930A to the T-1 test access points is the next step. Figure 6-15 shows a typical connection for single direction testing at the DSX jackfield. At the far end the span can be looped back or another 930A (or any T-1 BER test set) may be sending back a test pattern.



Test Cord Connections For Single Direction BERT
Figure 6-15

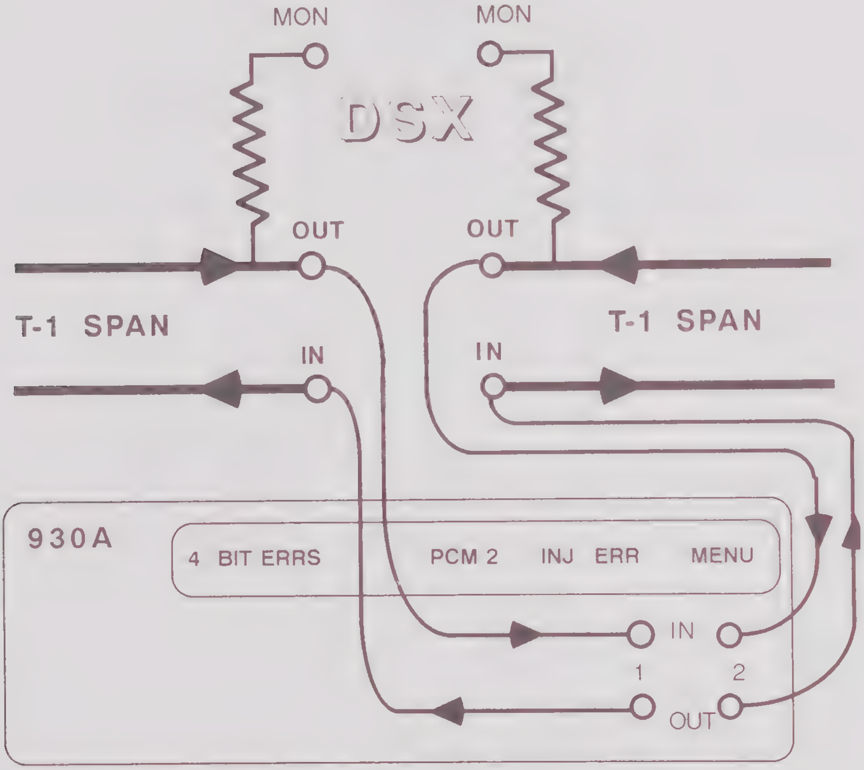
The 930A DEFAULTS are chosen such that you do not normally have to use the SET-UP menu to run a simple BERT test. For 90% of your testing all you need to do at this point is press Softkey 2 under TEST. The 930A will do the rest.

To begin testing at this point you press Softkey 2 under **TEST**. The factory default settings (located under **SET-UP**) are:

Pattern:	QRSS
Frame:	D4 Superframe
Clock:	Internal 1.544 Mbps ± 30 bps
Impedance:	100 Ohms
Line Coding:	AMI
Test Length:	Continuous

For most cases on a T-1 span, these defaults are what you need to perform a standard BER test.

If you have Option 930A-08E, then you have only the single direction **BERT** capability with Option 930A-22. If you have Option 930A-09E then you can do a single direction **BERT**, test **BERT** in both directions, or do a **BERT** on separate spans.



Test Cord Connections For Dual-Direction BERT
Figure 6-16

Both Side 1 and Side 2 of the 930A are always activated when you enter Menu Option 46 **if you have Option 930A-09E**. You can view either side during a test by pressing Softkey 2 under PCM1 to toggle between sides. If you do not connect anything to side 2 then all you will see if you toggle from PCM1 to PCM2 is a **NO SYNC** indication on side 2.

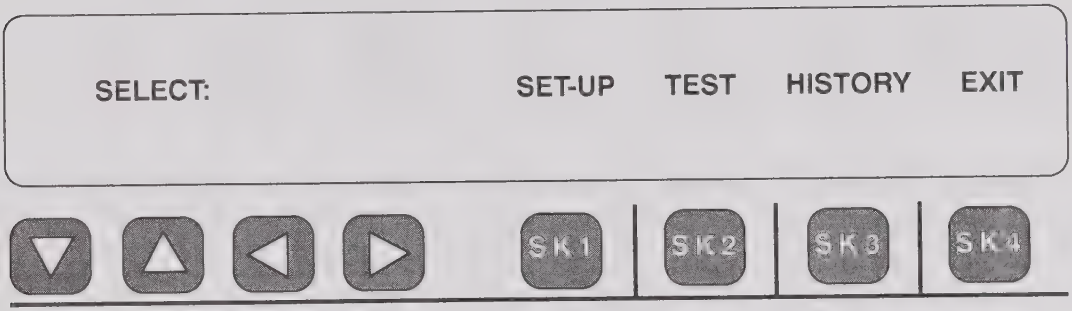
This makes the **BERT** feature very easy to use because it basically comes up running for most of your testing needs. All you have to do is hook up the test cords and select **TEST** from the **BERT** menu.

If you want to use a different pattern, operate Loop-Timed to the span or change some other parameter, you should read section 6-17.2 first.

6-17.2 HOW TO CHANGE TEST PATTERNS, FRAMING AND OTHER PARAMETERS

This will go faster if we start at the beginning with the main **BERT** selection menu.

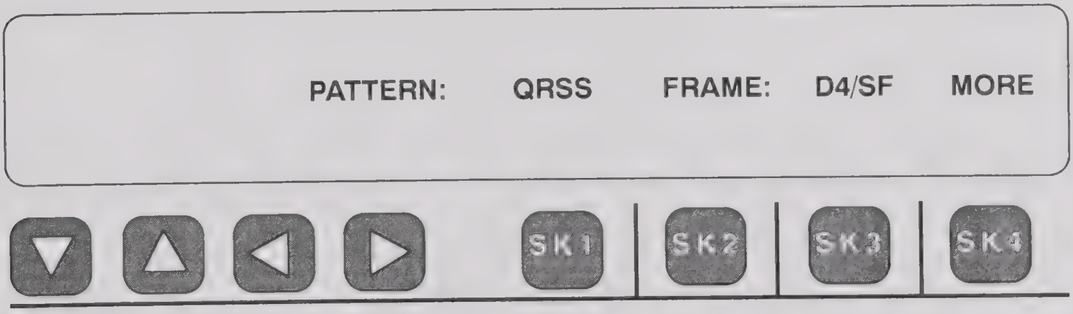
The moment you enter Menu Option 46, the 930A sets itself to the T-1 factory defaults or whatever you set in last. The previous Trunk Type setting does not matter. The 930A will flash a short message to inform you that it is setting itself to T-1.



WARNING

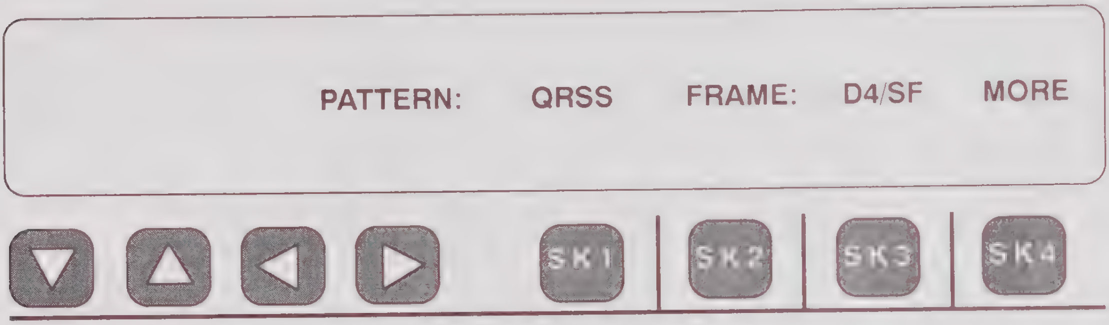
Be sure the T-1 span you are connected to is out-of-service before you enter Menu 46.

To check or change the test parameters, press Softkey 1 under **SET-UP** in the main **SELECT** menu and the following display will appear.



The most common things you want to change are the test pattern, framing and clock source so they are located right up front.

The default test pattern is **QRSS** and the default framing is **D4 Superframe** which is the most common format.

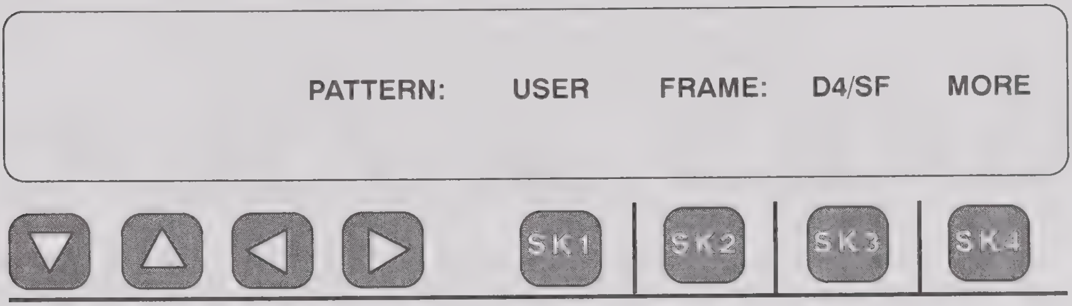


To change the test pattern, press Softkey 1 under **QRSS** and the other choices will appear. The order of appearance after **QRSS** is as follows:

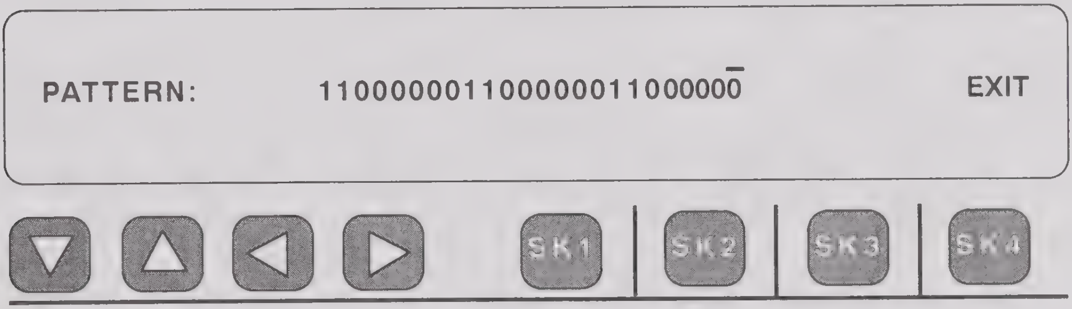
QRSS	Quasi-Random Word
USER	User definable pattern up to 24 bits long
1:1	Alternating 1 and 0 pattern
1:7	A 1 followed by seven 0's (also 1 in 8 pattern)
3:24	Three 1's in 24 bits (a stress pattern)
ALL 1's	All ones pattern (Blue Alarm)
55 OCTET	A special 440 bit long stress pattern
$2^{23}-1$	A pseudo-random sequence 8 megabits long
$2^{20}-1$	A pseudo-random sequence 1 megabit long
$2^{15}-1$	A pseudo-random sequence 32 kilobits long
$2^{11}-1$	A pseudo-random sequence 2047 bits long
$2^{9}-1$	A pseudo-random sequence 511 bits long

The only one of these patterns that requires any explanation is the **USER** pattern.

To access the USER pattern, press Softkey 1 under QRSS in the display above. The following display appears:

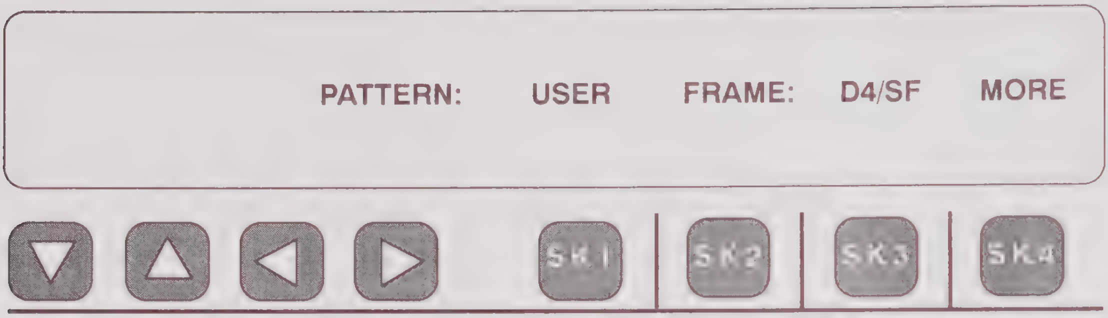

PATTERN: USER FRAME: D4/SF

When this display appears, press Softkey 4 under **MORE** and the **USER** Pattern display will appear. As an example, a pattern is shown already entered.


PATTERN: 110000001100000011000000

You can press the **CLR** (Clear) key to get rid of any existing pattern. Enter the pattern you want (up to 24 bits in length) using the **1** and **0** keys on the front panel. You can edit the pattern by using the **LEFT/RIGHT** arrow keys to position the cursor over the digit you want to change. Then enter a **1** or **0** from the keypad to overwrite the digit.

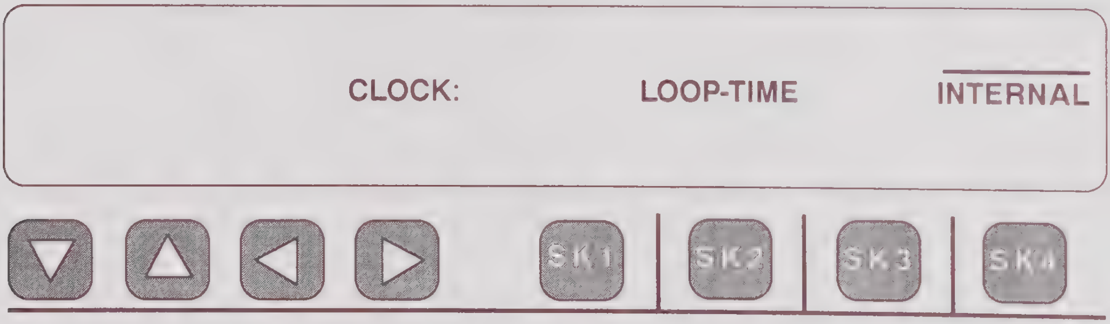
Once you have set the pattern up, just press Softkey 4 under **EXIT**. The pattern you input becomes the test pattern the 930A will use when you enter the **TEST** menu. By using the 930A's **STORE** and **RECALL** functions you can store up to 39 different **USER** patterns for future recall.



To change the Framing format, press Softkey 3 under **D4/SF** and the other choices will appear. In order of appearance after the default of **D4/SF** they are:

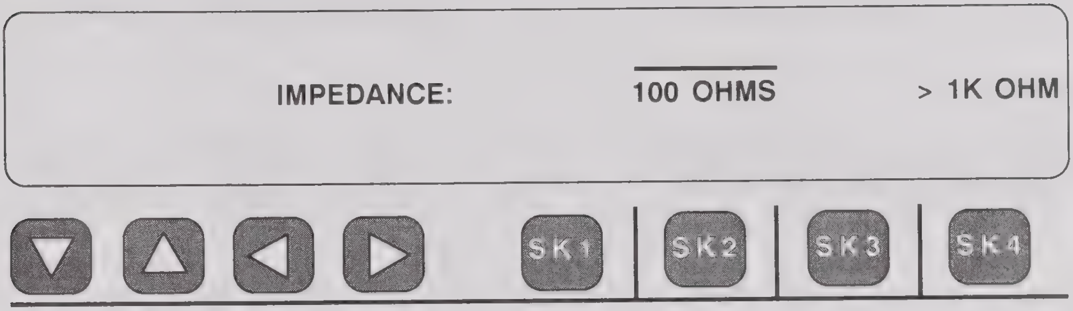
D4/SF
ESF
UNFRAMED

You choose which one you want by pressing Softkey 3 until your choice shows on the display. Press the **OPTION MENU** key to return to the main menu or press Softkey 4 under **MORE** to advance to the next parameter choice. The next most likely parameter to change is clock source and its display is:



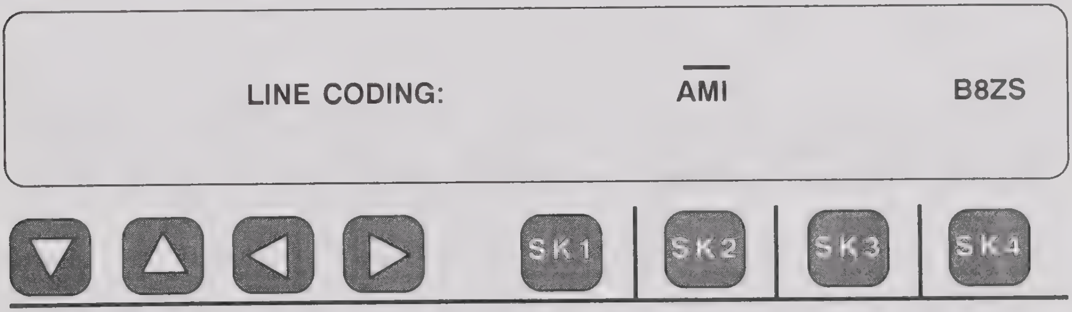
To change CLOCK SOURCE, you select either **LOOP-TIME** or **INTERNAL** clock as appropriate. The default is **INTERNAL** which means the 930A is supplying the 1.544 Mbps clock. The older BER test sets operated that way. If you are testing on a T-1 span the chances are good that you can derive clock from the span. In other words, you may want to be loop-timed. To select **LOOP-TIME**, press Softkey 2 under **LOOP-TIME** and the display will advance to the next choice. Pressing the **OPTION MENU** key will take you back to the main menu.

The next parameter choice is **IMPEDANCE**. The display is:



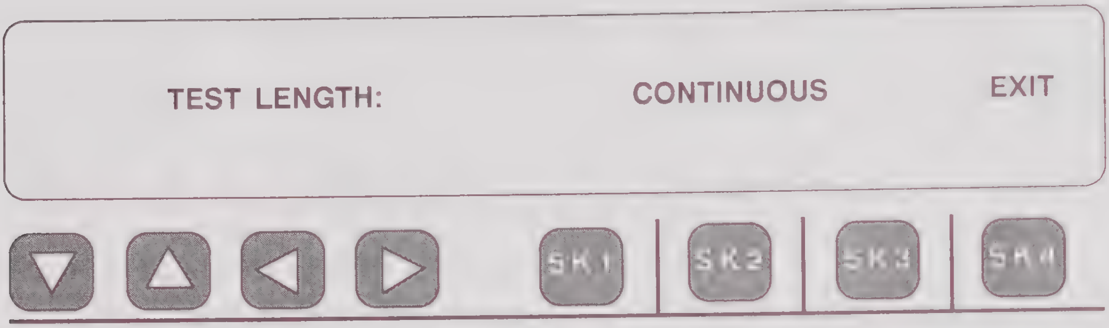
IT IS NOT GENERALLY NECESSARY TO CHANGE THE IMPEDANCE from its 100 OHM default. Since BER testing is done at the transmit and receive sides of the T-1, the 100 Ohm default should be used. BER testing is not a bridged measurement.

After you press Softkey 2 under 100 ohms (or Softkey 4) the 930A display will advance to the next choice.

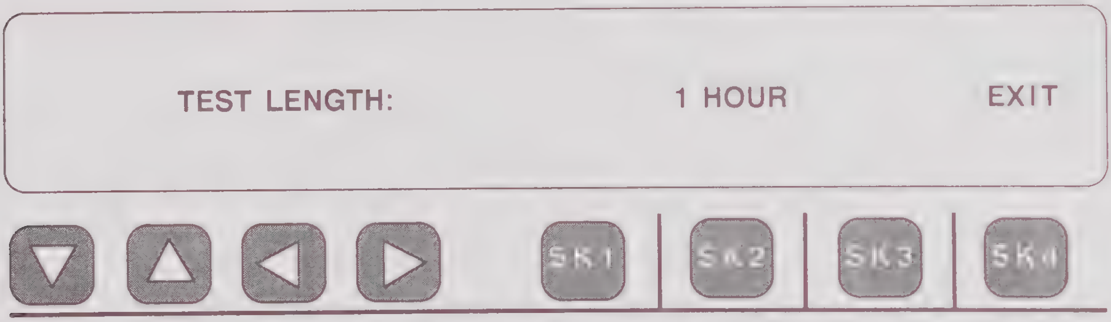


LINE CODING should definitely be left at the default setting. The default has been chosen to be Alternate Mark Inversion (**AMI**) because this is currently what most, if not all, T-1 carrier systems use. However, if you are using the 930A in a laboratory environment, or some other place where you may run across Bipolar 8 Zero Substitution (**B8ZS**) line coding, press Softkey 4 to change to **B8ZS**.

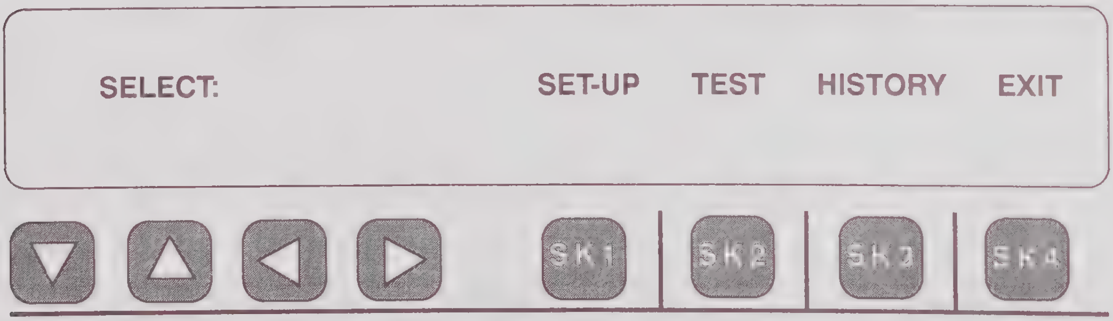
After selecting **AMI** or **B8ZS**, the display advances to the final choice which is **TEST LENGTH**.



The default test length is **CONTINUOUS** which means the 930A will run the BERT test until you turn it off. But there are times when you may want to test a circuit for a specific time. The 930A allows you to choose test lengths of 15 minutes, 1 Hour, or 24 Hours duration in addition to running continuously. You can select one of these other choices by pressing Softkey 2 under **CONTINUOUS** until the time you want is displayed.



Once you have done this, press Softkey 4 under **EXIT** to return to the main select menu.



You do not have to run through all of the set-ups just to change one parameter. When you get to the one you want to change just change it and then press the OPTION MENU key to get outside again.

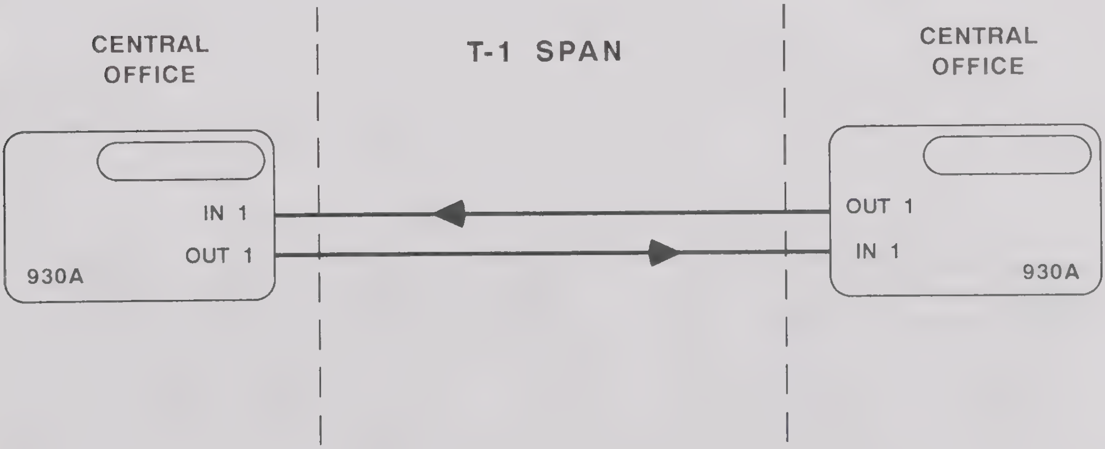
6-17.3 BER TESTING T-1 INTEROFFICE FACILITIES WITH THE 930A

Once you have set-up the 930A or decided to use the defaults, you are ready to connect the 930A to the T-1 facility you want to test.

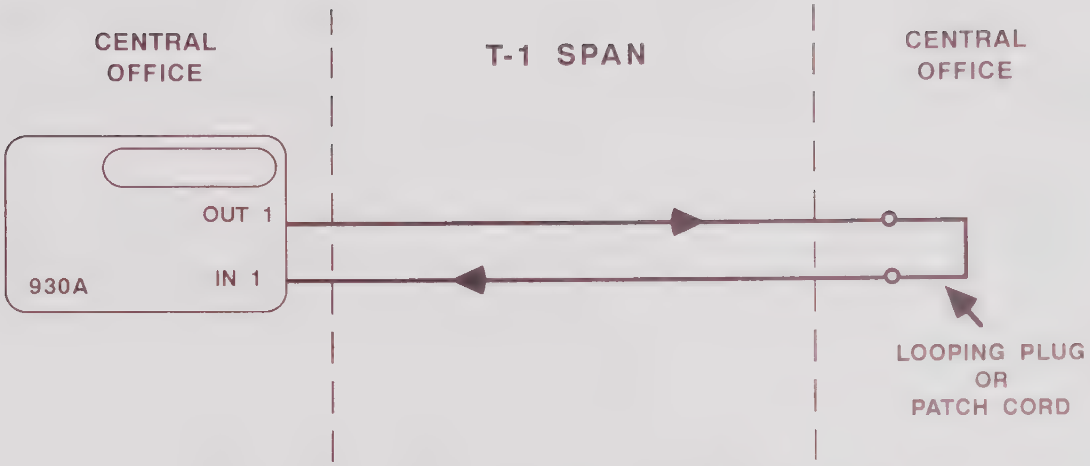
Before you start to test, you must be sure that the T-1 has been removed from service. Bit Error Rate testing is only done on out-of-service facilities because you will be sending a pattern down the T-1. If anyone was talking on one of the channels at that time they would be knocked off the line.

You can make **BER** measurements end-to-end using a **BERT** set at each end, or you can have someone at the far end put up a patch to "Loop Back" the span. In any event, the principle is simple. The 930A sends out a known pattern (QRSS for example) and then it compares what it gets back bit for bit to see if there is a difference between what was sent and what was received.

TEST CONNECTION FOR BIT ERROR TESTING END-TO-END



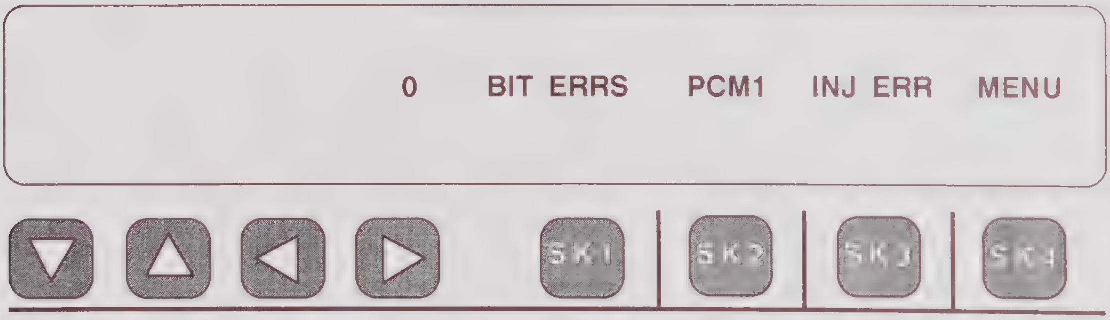
To do a **BER** test using the set-up above, all you have to do after you connect the test cords is go to Menu Option 46 on each unit, enter the Menu Option and press the softkey directly under the word **TEST**. This assumes that you are using the factory default settings in both units. If you see the words "**NO SYNC**" above Softkey 3 on the display, the chances are that the units are set to different patterns or some other parameters are different. A check of the **SET-UP** menu in each unit will reveal the differences. Both units must be set to the same patterns and parameters to achieve sync.



TEST SET-UP WITH FAR END LOOPED BACK

If the far end is looped back then all you have to do is use the factory defaults for testing.

In either case, after you press Softkey 2 under **TEST**, the 930A display should look like:



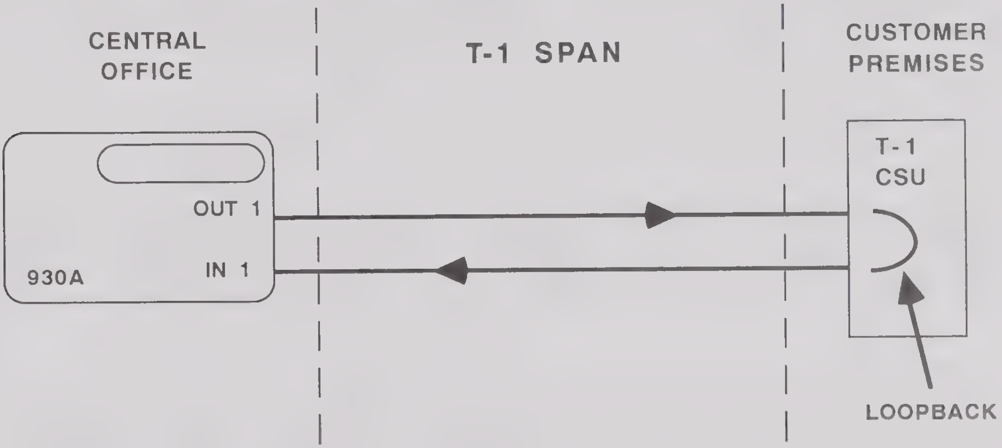
If you see **NO SYNC** instead of **INJ ERR** then recheck the patterns, etc. and test cord connections. Have the far end check what they are sending or if they have looped back the right T-1 span.

When you have SYNC, press Softkey 3 under **INJ ERR** to see that the far end receives 1 error or that the 930A sees the error on a looped back span.

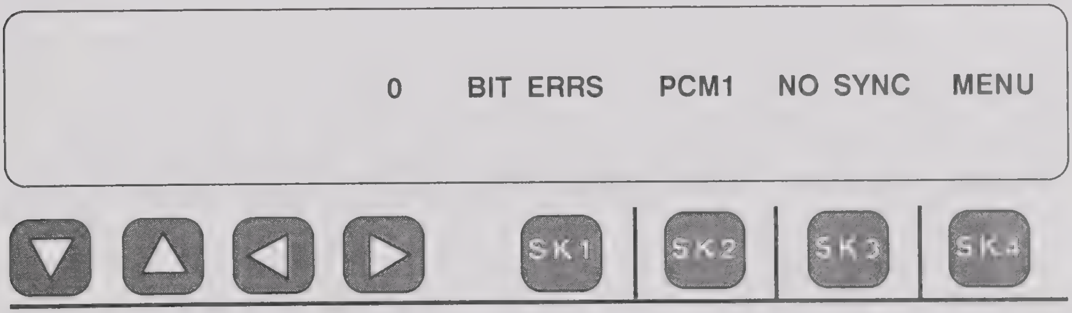
Press the **CLR** (Clear) key to reset the counters to zero before you begin testing.

6-17.4 TESTING TOWARD A T-1 CSU WITH THE 930A

When testing on a T-1 facility that terminates into a T-1 Channel Service Unit (CSU) on a customers premises, you can have the 930A send the **LOOP-UP** code toward the CSU. This causes the CSU to loop the T-1 back toward you. You do not need someone at the far end. The test cord connection is shown below:

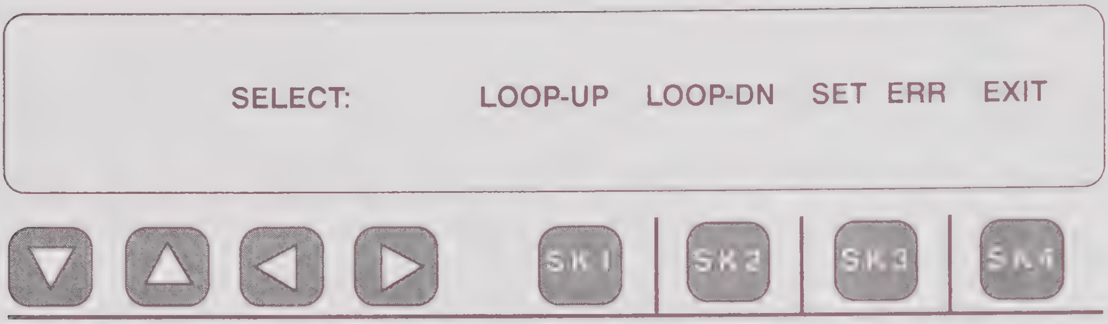


After you have connected the test cords to the 930A, entered Option Menu 46 and pressed Softkey 2 under **TEST**, you will see the following display:



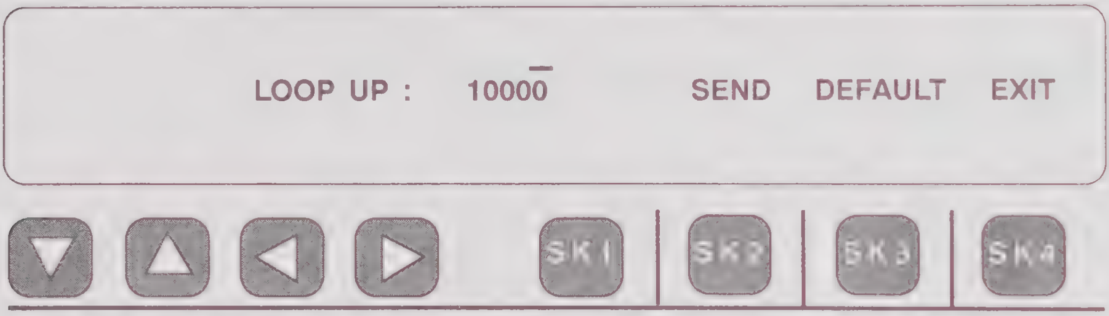
```
0    BIT ERRS    PCM1    NO SYNC    MENU
```

Note that there is a NO SYNC indication on the 930A display, because no pattern is coming back from the far end. You must **loop back the CSU** by sending it the **LOOP-UP** code for approximately 5 seconds. To do this with the 930A, press Softkey 4 under **MENU** and the **SELECT** display will appear.



```
SELECT:          LOOP-UP   LOOP-DN   SET ERR   EXIT
```

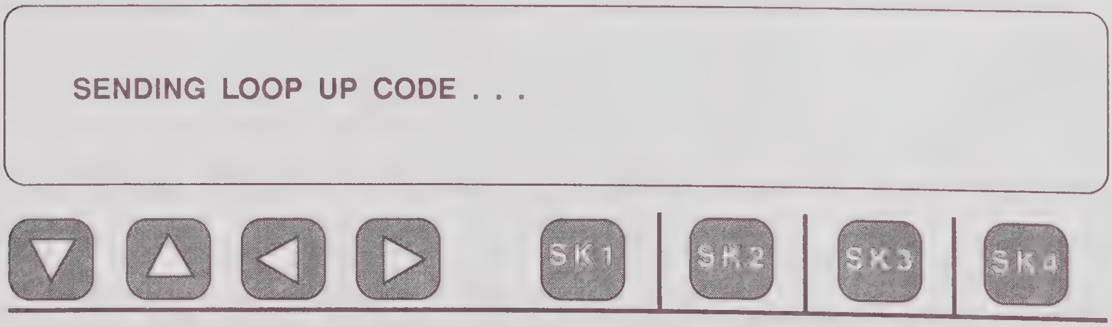
To Loop the CSU you start by pressing Softkey 1 under LOOP-UP and the display will change to:



```
LOOP UP :   10000        SEND   DEFAULT   EXIT
```

The default Loop-Up code shown above is the most common code and is sometimes referred to as the Verilink code. Loop-Up is purposely a 2-stage process so that you cannot accidentally send out the code. It also gives you a chance to edit the pattern at this point. You may want to enter a Loop-Up code for a Network Interface (a different device and code than a CSU). The **CLR** (Clear) key will clear the displayed pattern. Edit the pattern by moving the cursor over a digit and changing it to a **1** or a **0**.

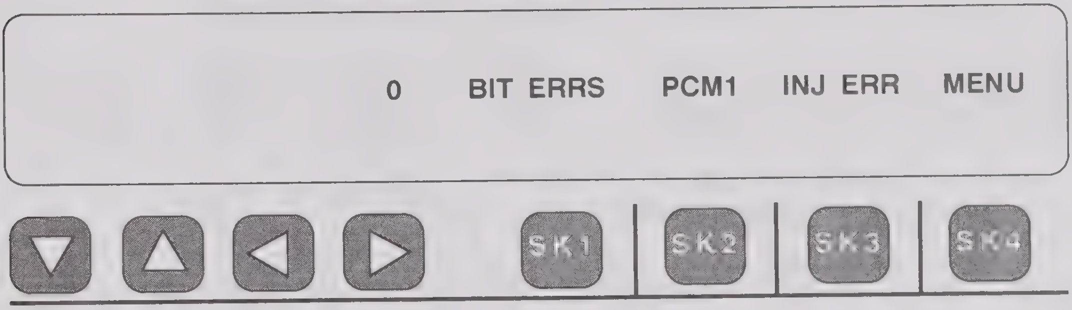
To send the Loop-Up code, press Softkey 2 under **SEND**. The 930A display will show:



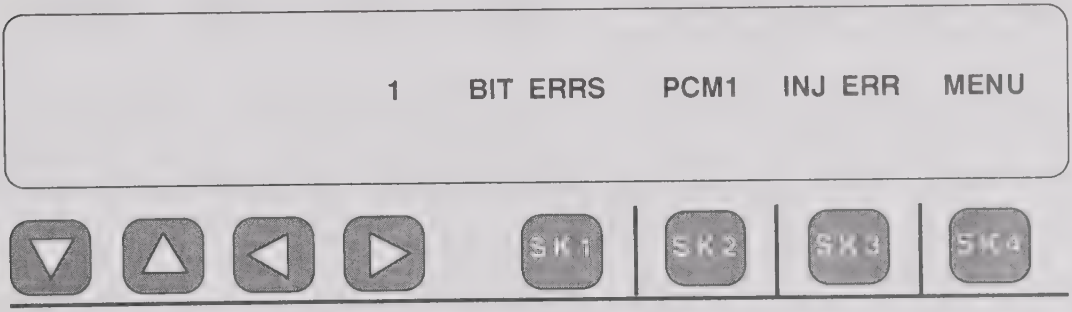
```
SENDING LOOP UP CODE . . .
```

When the Loop-Up has been achieved the 930A will display the words **"REMOTE LOOP UP SUCCESSFUL"**. If Loop-Up is not successful the 930A will announce **"REMOTE LOOP UP UN-SUCCESSFUL"**.

After achieving Loop-Up the 930A display will change immediately to the main BERT menu.

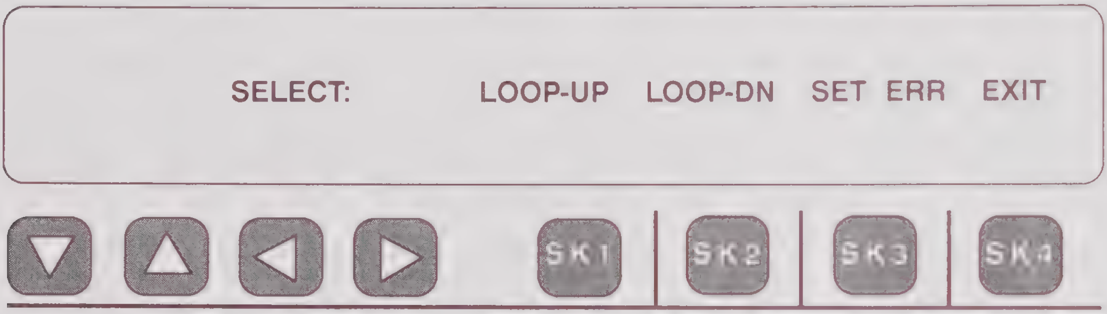


Note that now the 930A has achieved SYNC. The **NO SYNC** message has been replaced by the **INJ ERR** function. To test the integrity of the Loop you can inject a single error to see if the 930A counts it coming back. Press Softkey 3 under **INJ ERR** once and the 930A display should change to:

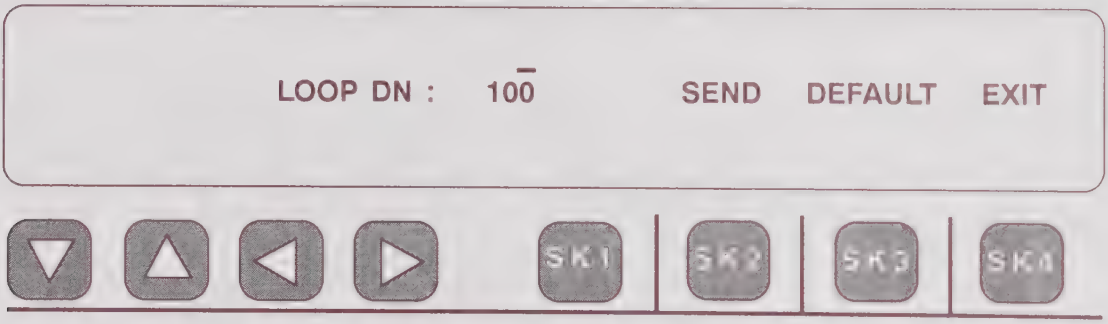


If you see the error coming back you know you have a good loop. Press the **CLR** (Clear) key to zero the counters and let the 930A run. If you do not see any errors (scroll through all the counters using Softkey 1 or the **UP/DOWN** arrow keys) in 15 minutes the span is probably working. If the problem is intermittent then you should run the test for at least 24 hours.

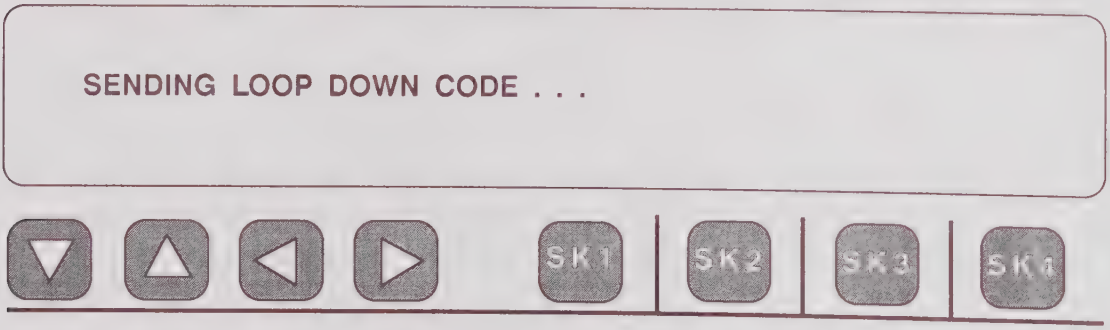
After your testing is complete, press Softkey 4 under **MENU** to get back to the **SELECT** menu.



Then press Softkey 2 under **LOOP-DN** and the display will change to:



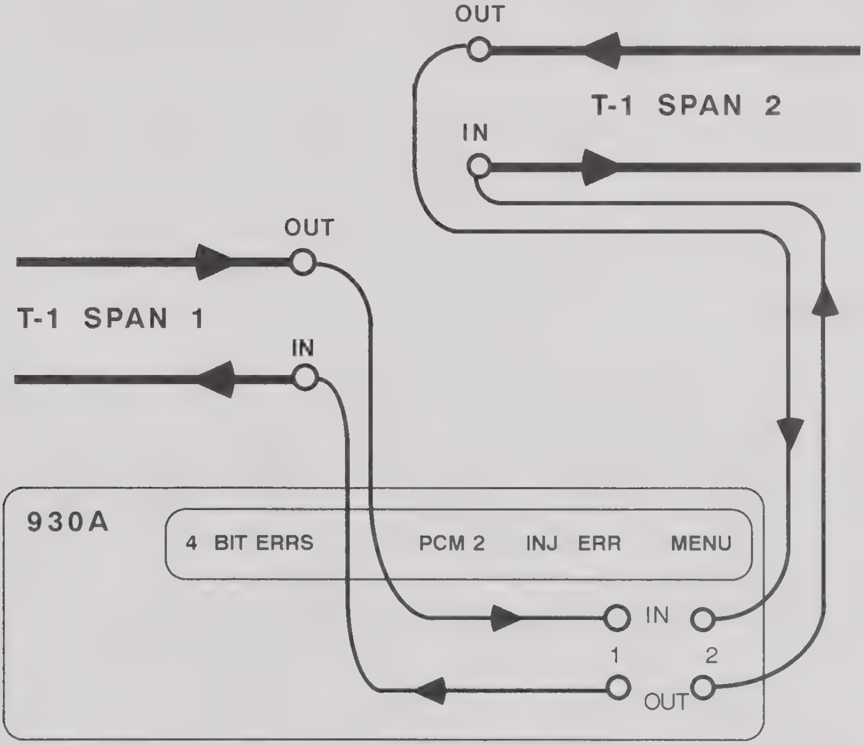
Finally, press Softkey 2 under **SEND** to restore the CSU to normal operation. If you are connected to a standard CSU then the default Loop-Down code (shown above as 100) is what you want to send. If you need to send another code then edit the pattern first before you press **SEND**.



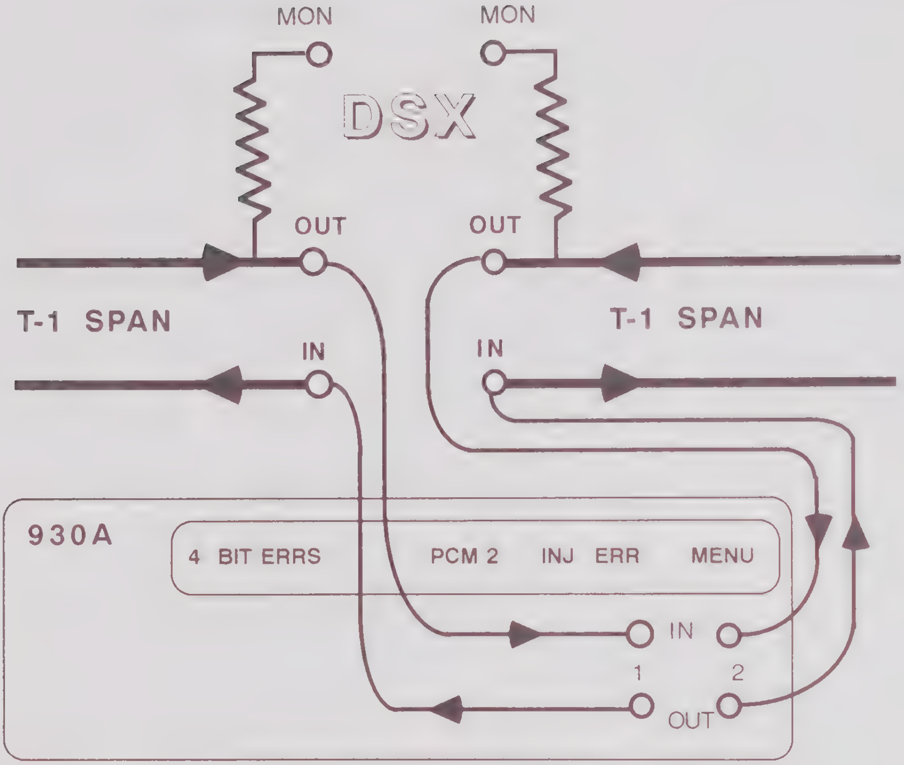
When the Loop has been taken down, the 930A will announce "**REMOTE LOOP DOWN SUCCESSFUL**". It will then revert to the main BERT display but should now indicate "**NO SYNC**" since there will be no returned pattern.

6-17.5 BER TESTING TWO T-1 SPANS SIMULTANEOUSLY

When the 930A is equipped with purchased Option 930A-09E and 930A-22 it gives you the equivalent of two BERT sets. Because the two PCM interface boards which make up Option 930A-09E are identical, both are enabled when you enter Menu Option 46. This means that you can connect the jacks labeled PCM 1 IN/OUT and test one span while you connect PCM 2 IN/OUT to another span. All you have to do after you are connected is to press the softkey under TEST. After that you press Softkey 2 under PCM1 to toggle between looking at the errors on Side 1 and those on Side 2. The test connection is shown below.



This connection would be used to test two separate T-1 spans. But there may be times when you are in the middle between two other offices and you might want to do a BER test toward each office simultaneously. The diagram on the following page shows this connection.

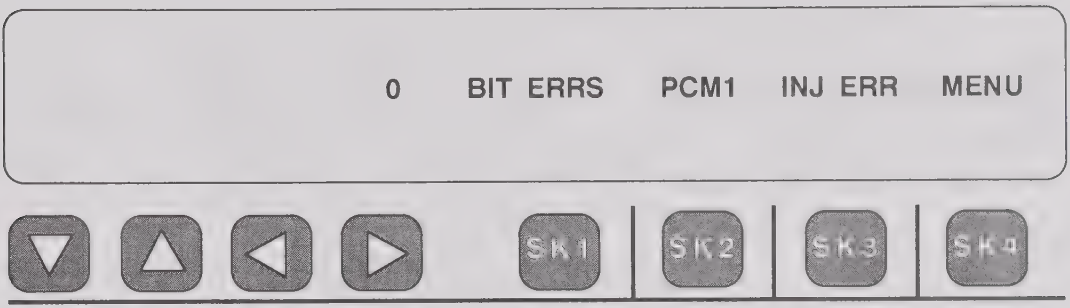


In this case, the T-1 span is broken at the intermediate office and the 930A is doing a **BER** test toward the two end offices. This can save you a lot of time especially if you have to do a 24 hour test in each direction. This feature lets you test both directions at the same time so you save 24 hours.

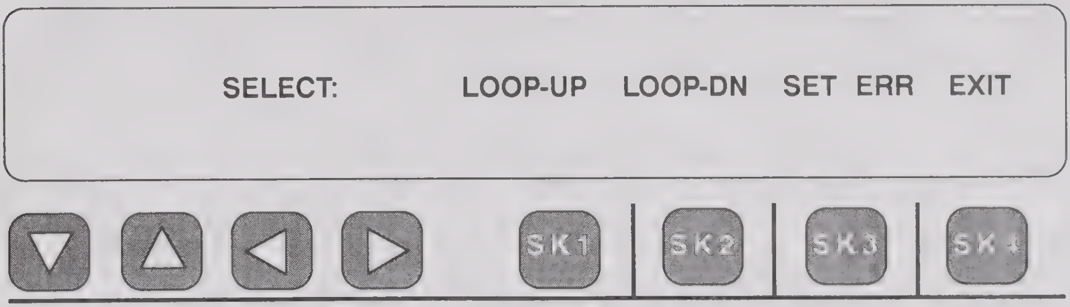
Again, the **HISTORY** for both sides is accumulated and all you have to do to check on the test is to press Softkey 2 to toggle between Side 1 and Side 2 results.

6-17.6 HOW TO SEND ERRORS AND SELECT OTHER TYPES

The factory default injects single bit (or logic) errors when the softkey under **INJ ERR** on the main BERT display is pressed.

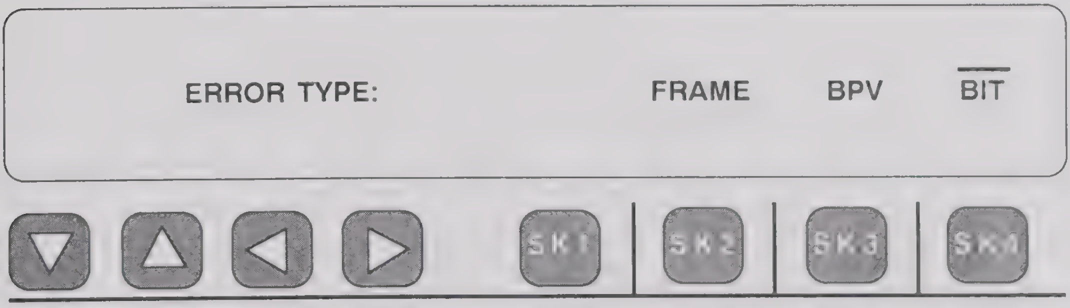


To change the type of errors being injected, press Softkey 4 under **MENU** to bring up the main **SELECT** display.

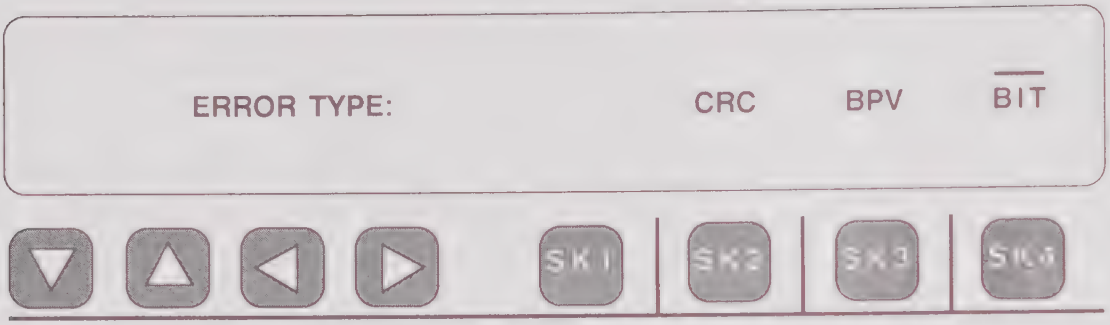


Press Softkey 3 under **SET ERR** to bring up the **ERROR TYPE** display. There are three possible displays depending upon whether you have chosen D4/Superframe, ESF or Unframed operation.

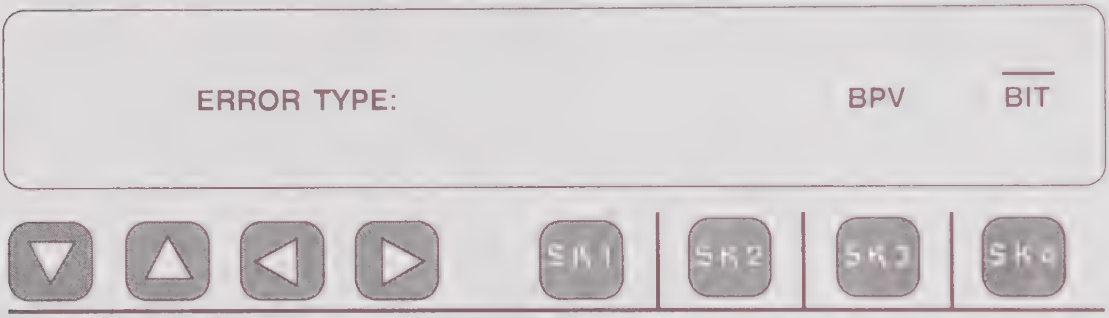
D4/SUPERFRAME



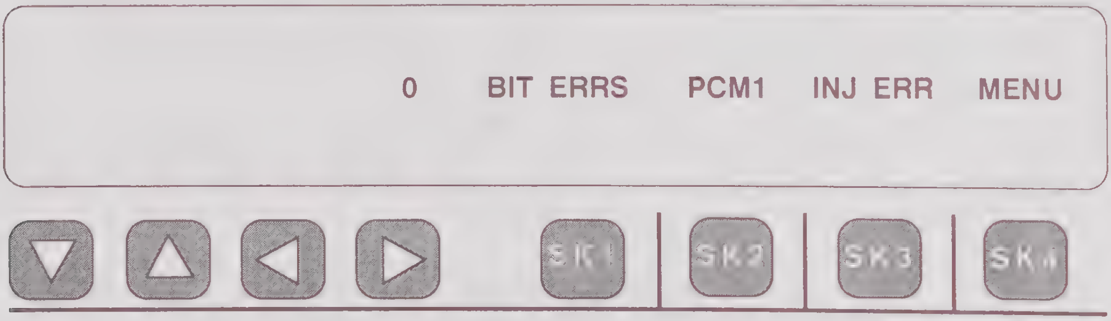
ESF



UNFRAMED



You press the softkey directly beneath the type of error you want to send and the 930A display returns you to the main BERT menu.



When you press Softkey 3 under **INJ ERR**, the 930A will send the type of error you selected.

6-17.7 TESTING A T-1 AUTOMATIC PROTECTION SWITCH (APS)

The 930A has a built-in APS test located in Menu Option 47: APS TEST. This is included as part of purchased option 930A-08E or -09E. This function is used to test a T-1 Automatic Protection Switch's ability to sense an error rate in excess of its threshold and switch to the standby T-1 span. The test consists of sending a BPV rate slightly below the switch's error threshold for 20 seconds to check for false triggering, then sending a BPV rate slightly above the threshold for 20 seconds to make sure that the protection switching is activated, then sending a BPV rate of one tenth the initial rate to make sure the switch restores the span to normal operation.

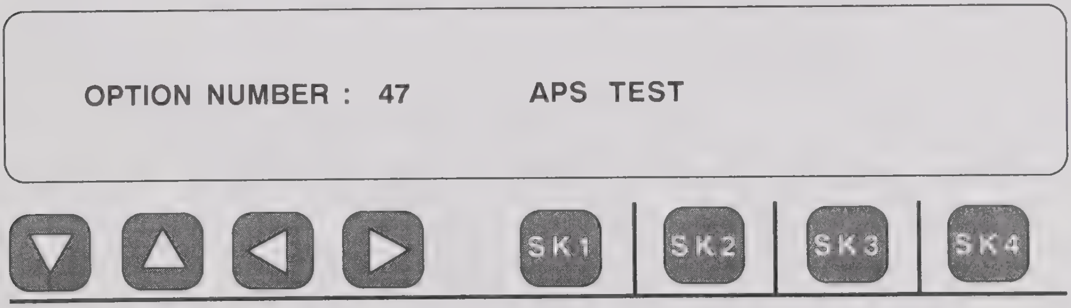
To use this feature, perform the following steps:

Press the OPTION MENU

function key.

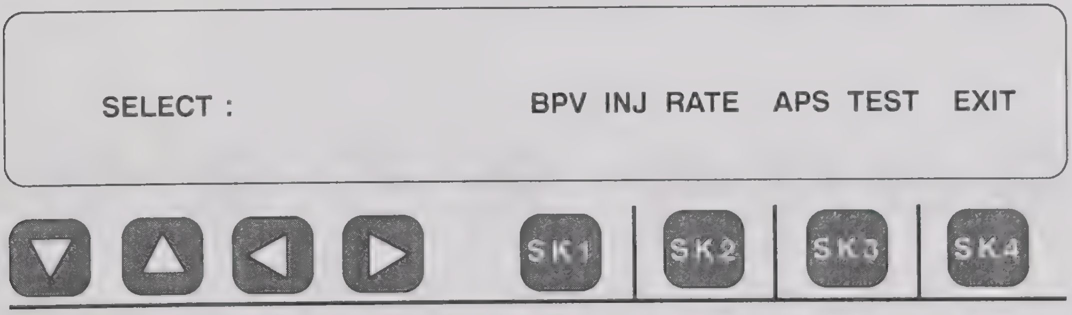
Use the UP/DOWN arrow keys to

select Menu Option 47: APS TEST.

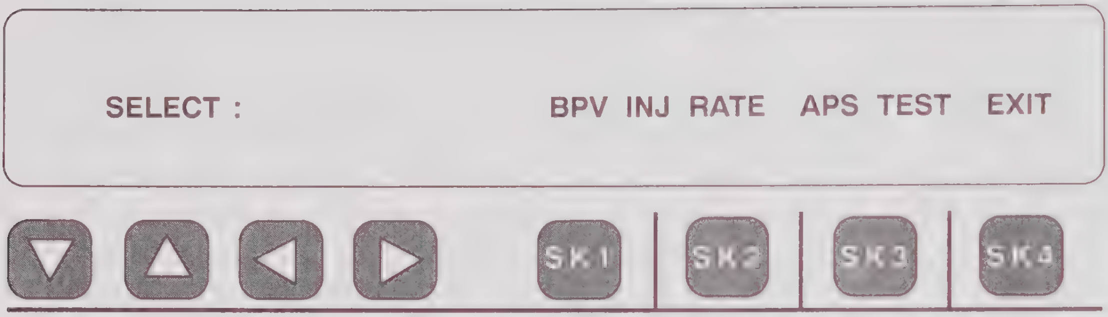


OPTION NUMBER : 47 APS TEST

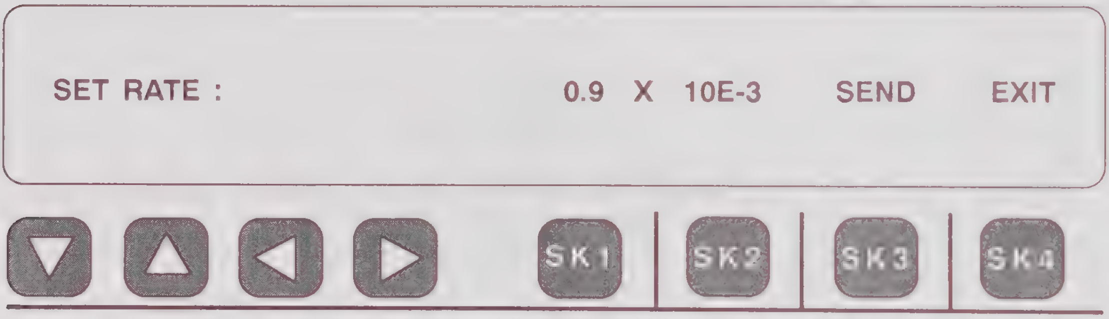
Press any softkey and you will get to the main selection menu:



SELECT : BPV INJ RATE APS TEST EXIT

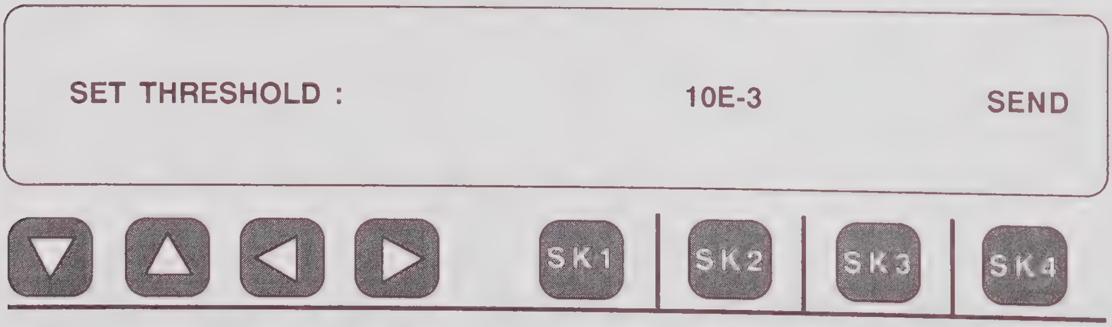


If you just want to send BPV's at a fixed rate, press Softkey 2 under BPV INJ RATE. You will get the SET RATE screen:



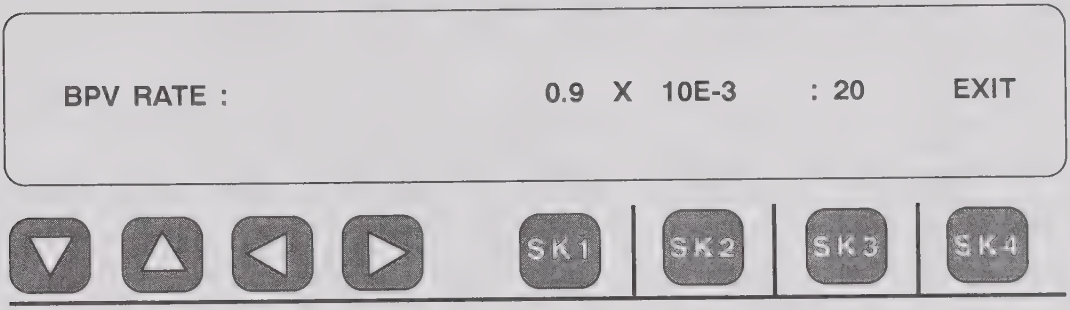
You can select a multiplier of 0.9, 1.0 or 1.1 by pressing Softkey 1 and you can select the rate exponent as 10E-3, 10E-4 or 10E-5. Once you have set the desired BPV rate, press Softkey 3 under SEND and the 930A will begin injecting errors at the selected rate.

To perform an automatic protection switch test, select APS TEST from the main menu above by pressing Softkey 3 under APS TEST. You will be asked to select the desired APS threshold:

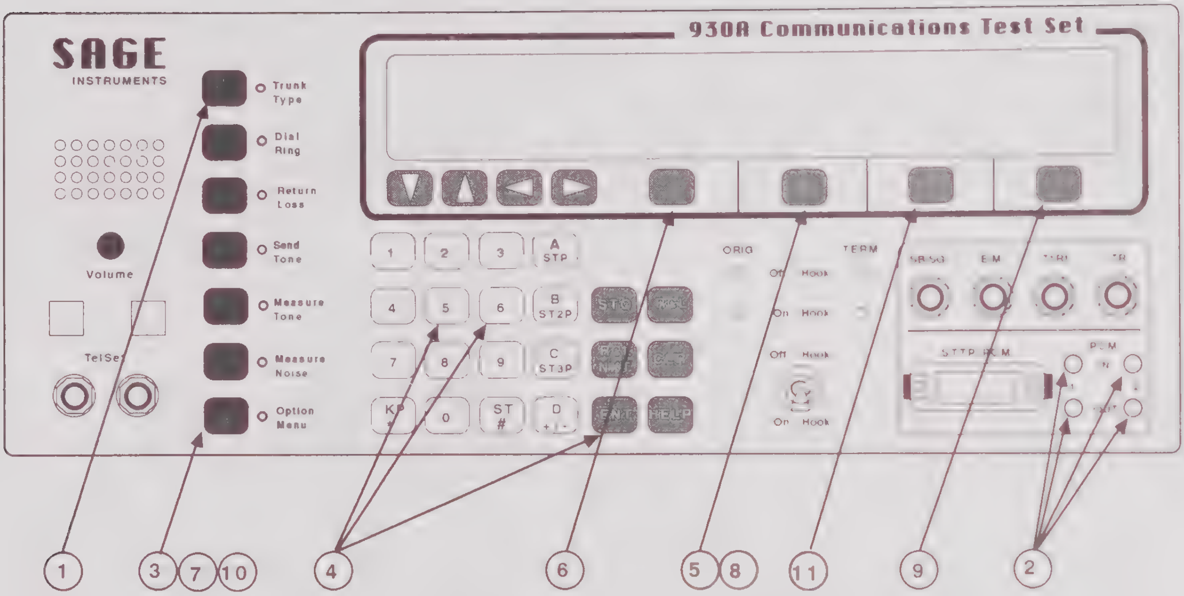


Select either 10E-3, 10E-4 or 10E-5 by pressing Softkey 2. Then press

Softkey 4 under SEND and the APS test will begin automatically. The 930A will send BPV's at a rate slightly below the selected threshold for 20 seconds. Then it will send at a rate slightly above the threshold for 20 seconds. Then it will send at a rate of one tenth the initial error rate to see that the switch returns to its normal state.



The display will look somewhat like the one above as the 930A runs through the APS test. The seconds are counted down from 20 on the counter above Softkey 3. You can terminate the test at any time by pressing Softkey 4 under EXIT. When the test is finished, the 930A returns you to the main menu.



To select and use **DS-0 Bit Error Rate Testing (BERT)**:

1. Set the TRUNK TYPE to PCM and select TERMINATE or D&I mode as described in Sections 6-1.1, 6-4 and 6-5.
2. Connect Test Cords for either single or dual-direction testing as shown in Figures 6-4, 6-5 and 6-6.
3. Press the **OPTION MENU** function key.
4. Enter the number **56** on the numeric keypad and press the **ENT** (Enter) key.
5. Press Softkey 2 under **TEST** to begin testing with the default settings, or skip this step to change defaults.

To check or change the default settings or patterns:

6. Press Softkey 1 under **SET-UP** in the main **SELECT** menu and use the softkeys to select and change default settings as required.
7. Press the **OPTION MENU** key to get back to the main menu.
8. Press Softkey 2 under **TEST** to begin testing.
9. Press Softkey 4 under **MENU** to select and send **LOOP UP/DOWN** codes or inject Errors.
10. Press the **OPTION MENU** key to return to the main menu.
11. Press Softkey 3 under **HISTORY** to review previous 24 hours test results, or press Softkey 4 under **EXIT** to stop testing.

DS-0 BIT ERROR RATE TESTING
FIGURE 6-17

6-18 DS-0 BIT ERROR RATE TESTING (BERT) WITH THE 930A (MENU OPTION 56)

If you have purchased Option 930A-22 for your 930A, you will find that Menu Option 56: **DS-0 BIT ERROR RATE (BER)** has been enabled. This feature enables you to test at the 56 KBps or 64 KBps rates. It does not test individual sub-rates such as 9.6 KBps. However, once you have tested the DS-0 path and found nothing wrong, the problem must be from the Office Channel Unit (OCU) or Channel Service Unit (CSU) back toward the terminal equipment. This means swapping out the suspected OCU plug-in or CSU/DSU or hauling out the Protocol Analyzer anyway so why add steps to the test. The purpose of the DS-0 BERT in the 930A is to help you quickly sectionalize the problem. If you can point the finger at the devices connected to the DS-0 path and away from the transmission facility itself then this has been accomplished.

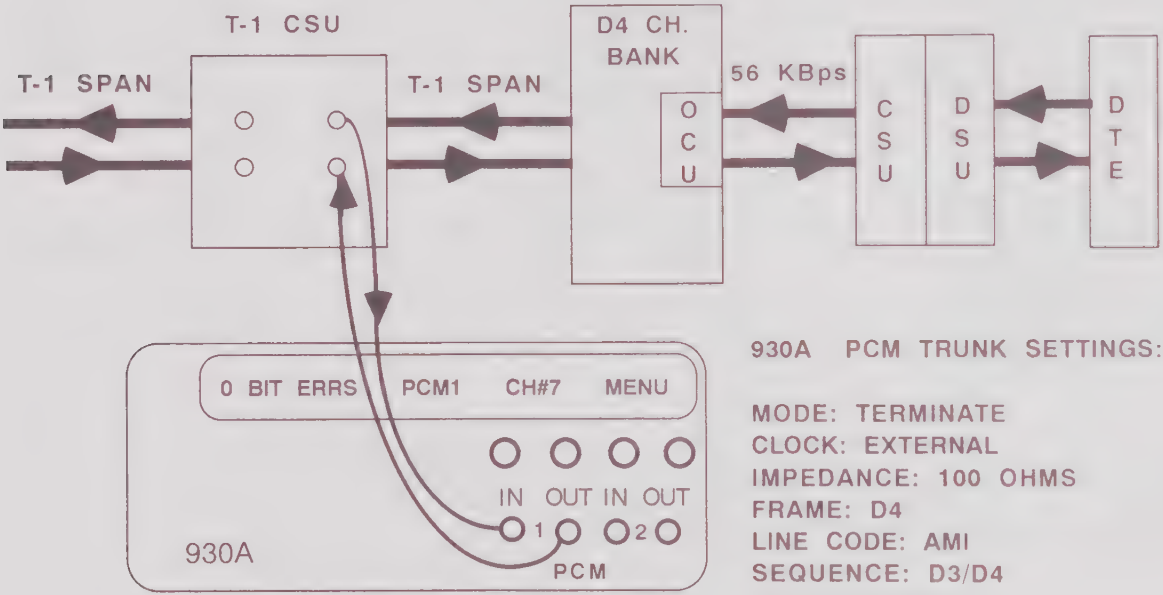
The DS-0 BERT is used with the 930A in PCM TRUNK TYPE. The Terminate mode or Drop and Insert mode can be selected. The following sections outline test cord connections, BER testing in various situations, how to send Loop Up and Down codes and how to change the test parameters if you have to.

The 930A itself can throw a loopback on a particular channel. This loopback can be for analog signals such as tones or it can be for digital patterns. This is discussed later on in this section.

6-18.1 HOW TO SET UP THE 930A FOR DS-0 BER TESTING

When you want to do a **DS-0 BER** test using the 930A, you first have to set the Trunk Type up to **PCM** and then select the correct mode (**Terminate or D&I**). Setting up the PCM Trunk Type is outlined in Section 6-1 pages 6-1 to 6-11. A brief reminder of the test cord connections and trunk settings is diagrammed below.

To Terminate a T-1 span and run a DS-0 BER Test on a channel:



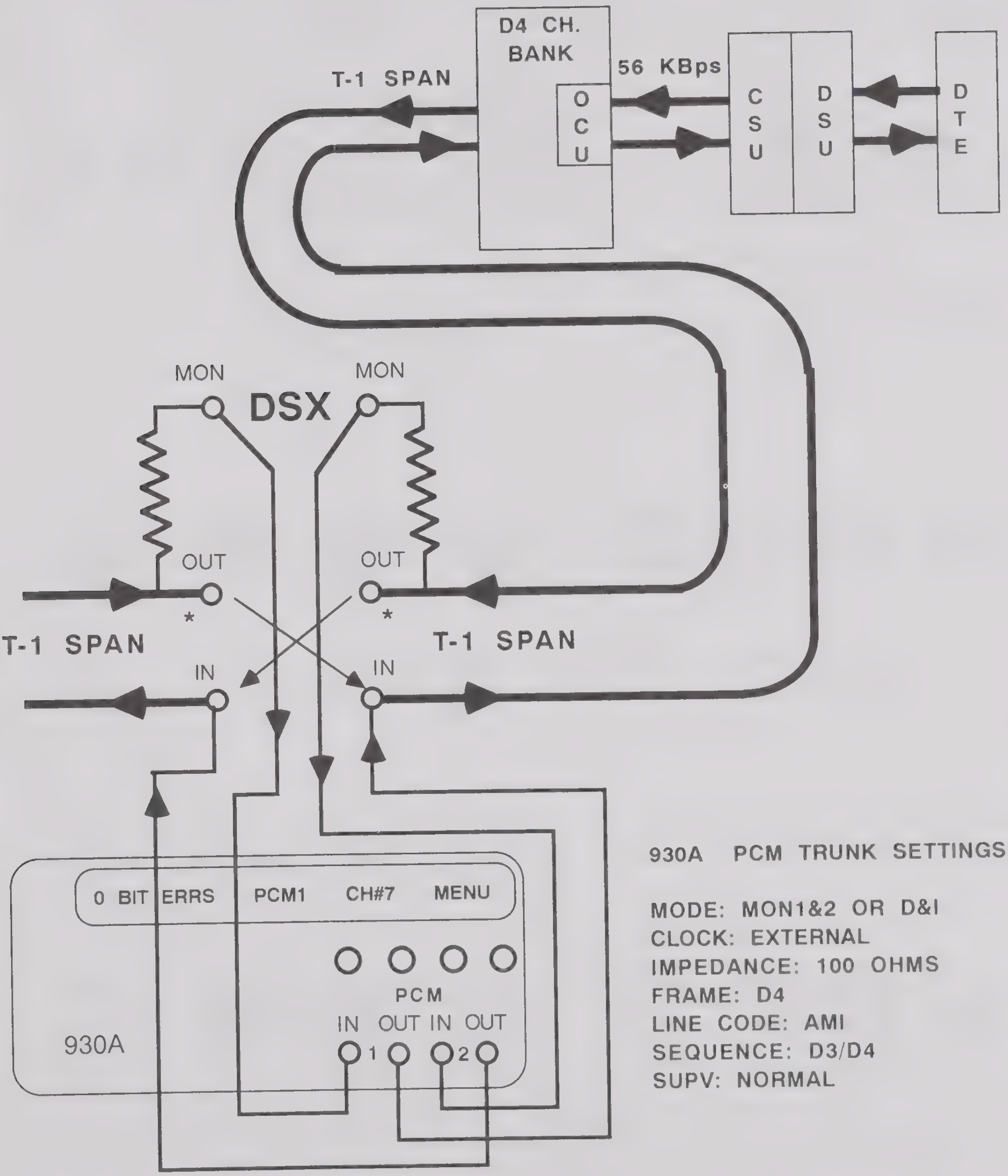
930A PCM TRUNK SETTINGS:

MODE: TERMINATE
CLOCK: EXTERNAL
IMPEDANCE: 100 OHMS
FRAME: D4
LINE CODE: AMI
SEQUENCE: D3/D4
SUPV: NORMAL

In the above example the 930A has been connected at the Equipment side of the customers T-1 Channel Service Unit (CSU). The testing is toward the D4 Channel Bank. There is an Office Channel Unit (OCU) dataport plugged into time slot 7 or channel 7 on the bank. The 56 KBps output from the OCU is fed to a combination Channel Service Unit/Data Service Unit (DSU) which interfaces to the Data Terminal Equipment (DTE). To test the path, you would successively loop back the devices on the path and run a BER test until errors were found. Start by looping the OCU, then the 56 KBps CSU, then the DSU.

A diagram of the 930A connected for Drop and Insert testing is provided on the following page.

DS-0 BER testing with the 930A in Drop and Insert mode



930A PCM TRUNK SETTINGS:

MODE: MON1&2 OR D&I
CLOCK: EXTERNAL
IMPEDANCE: 100 OHMS
FRAME: D4
LINE CODE: AMI
SEQUENCE: D3/D4
SUPV: NORMAL

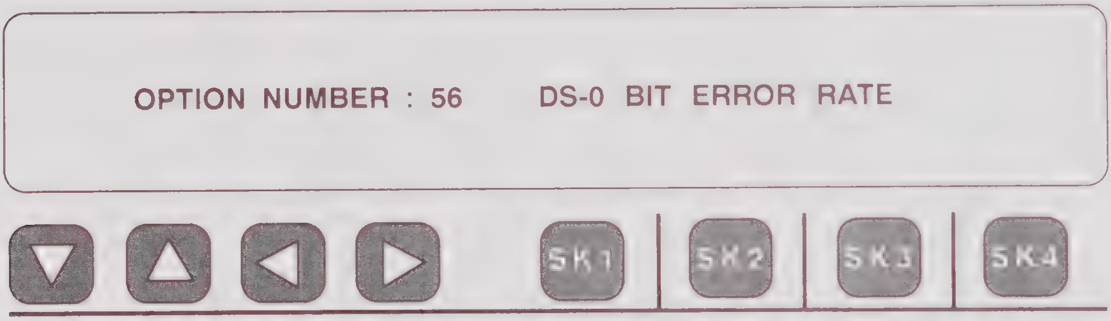
Once you have set the 930A correctly and connected the test cords, you can test in either direction on any channel you wish without disturbing the other 23 channels on the T-1 span. Details of D&I connections are contained in Section 6-3, pages 6-21 to 6-25.

After connecting the 930A to the span under test, the rest of the procedure consists of getting to the DS-0 BERT menu and running the tests. The following steps outline the set-up and test procedures.

Press the OPTION MENU function key.

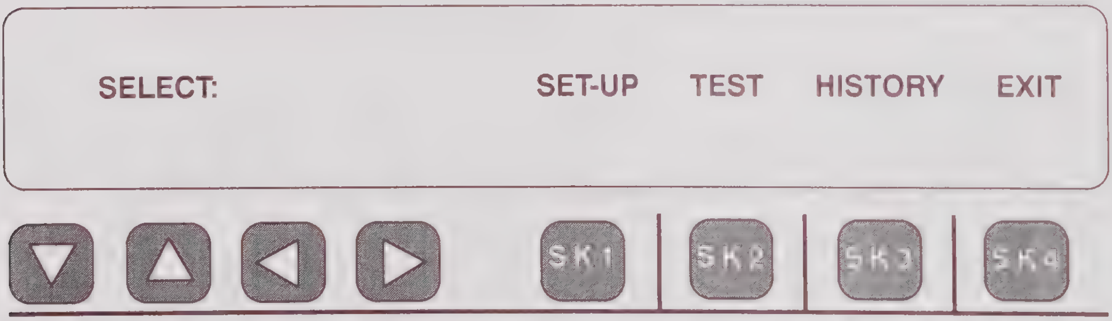
Use the UP/DOWN arrow keys to

get to **Menu Option 56: DS-1 BIT ERROR RATE**.



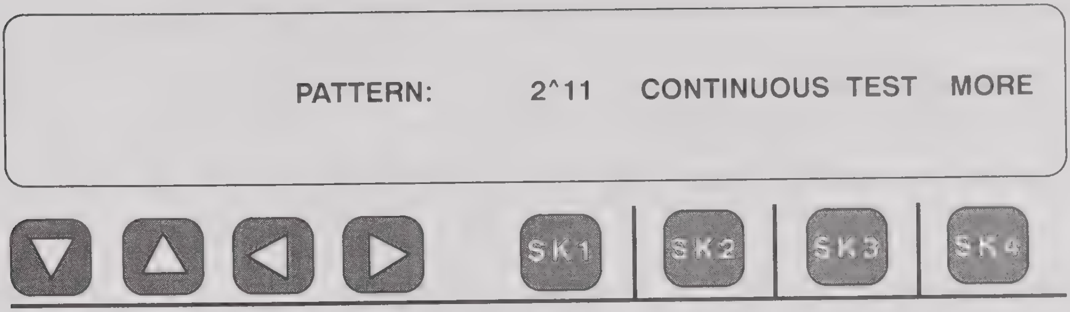
OPTION NUMBER : 56 DS-0 BIT ERROR RATE

Enter Menu Option 56 by pressing any of the softkeys under the display and the main selection menu will be displayed. You can also enter the number **56** from the keypad and then press the **ENT** (Enter) key.



SELECT: SET-UP TEST HISTORY EXIT

If you want to begin testing right away, press Softkey 2 under **TEST** and the 930A will start sending the last test pattern it was set to. Most of the time though, you will want to check your settings and maybe make some changes. Press Softkey 1 under **SET-UP** in the display above and the Set-Up menu will be displayed. An example is shown on the following page.



PATTERN: 2^11 CONTINUOUS TEST MORE

Here the default pattern is the pseudo-random sequence of 2^{11}-1 or 2047 bits length and the test will run continuously. You can choose other patterns by pressing softkey 1 to scroll through the choices. The patterns are:

2^{11}-1	(2047 bits)
2^{9}-1	(511 bits)
1 : 7	(a 1 and 7 zeroes)
USER	(user inputs any 8 bit pattern)

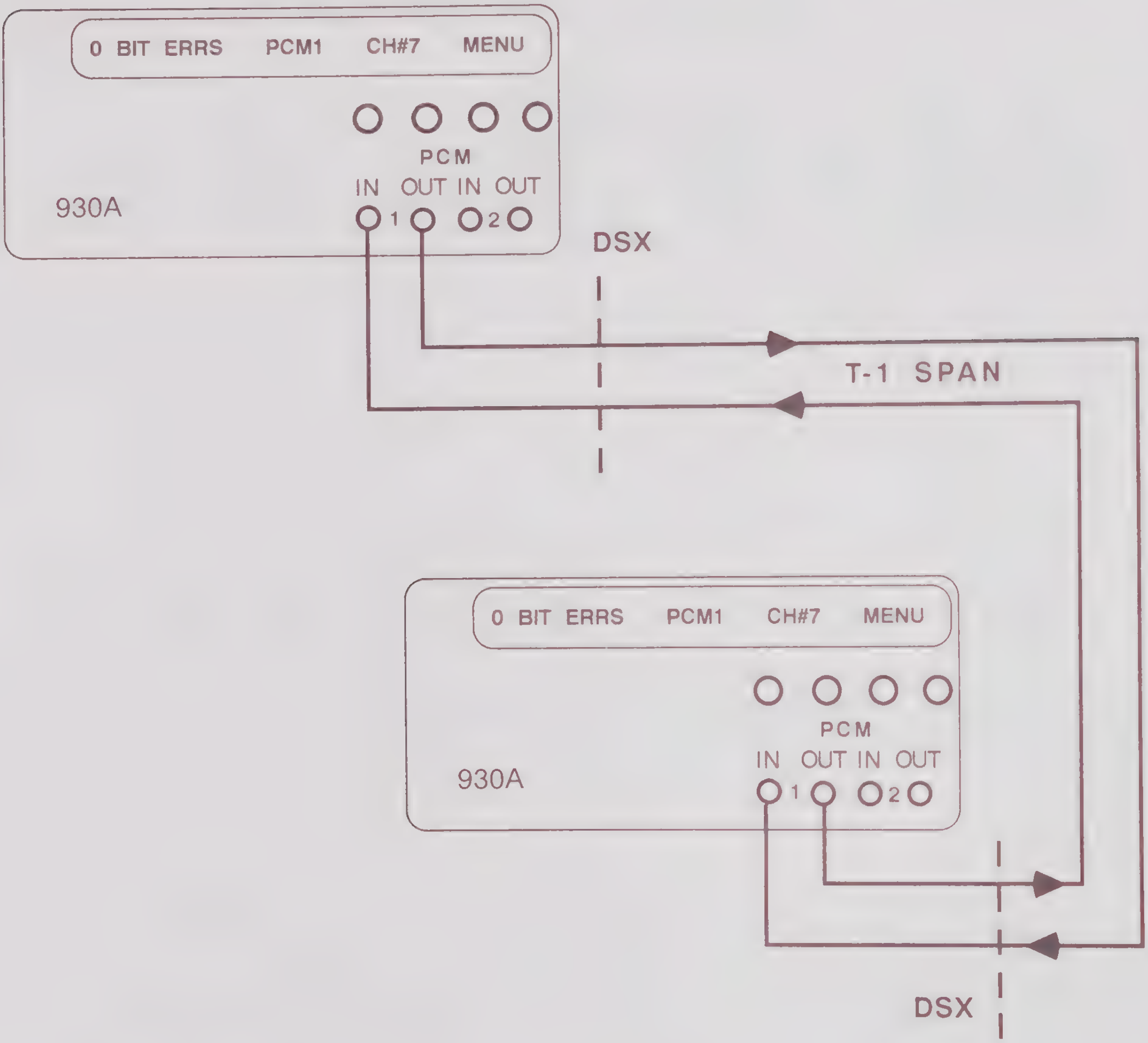
To input a USER pattern, select **USER** by pressing Softkey 1 until **USER** appears and then press Softkey 4 under **MORE**. You can then enter any 8 bit pattern of 1's and 0's you wish. The pattern will be continuously repeated when you begin testing. Press Softkey 4 under **EXIT** to return to the main menu.

The test length default is continuous but you can set the test length to run for 15 minutes, 1 hour or 24 hours if you want. Press Softkey 3 to choose which test length you want. Pressing Softkey 4 under **MORE** or pressing the Option Menu function key will return you to the main menu display.

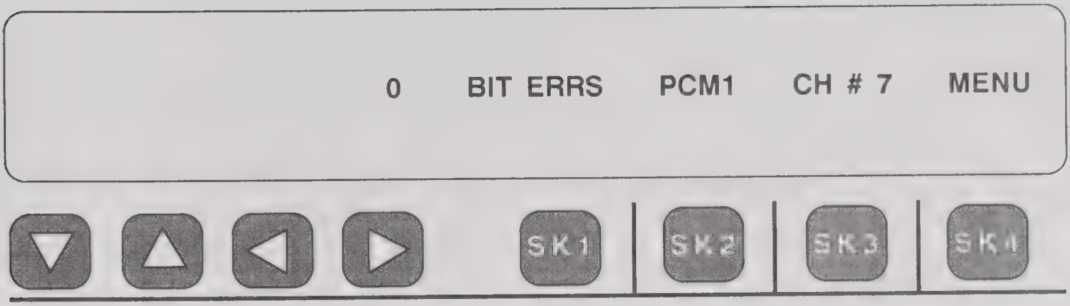
6-18.2 DS-0 BER TESTING

This section describes the steps and procedures used in testing 56 KBps and 64 KBps trunks carrying digital data. The first question you may have is "How do I tell the 930A whether the trunk is 56 KBps or 64 KBps?" The answer is that the 930A takes care of this for you when you set up the T-1 PCM Trunk Type. If you set the 930A for "AMI" line code and "Robbed Bit" signaling this tells it to set the DS-0 rate to 56 KBps. If you select "B8ZS" line code and "CCIS" signaling then the DS-0 rate is set to 64 KBps. So, setting up the T-1 trunk interface sets many of the parameters you need for DS-0 BERT. The next step is to determine how to test the DS-0 path.

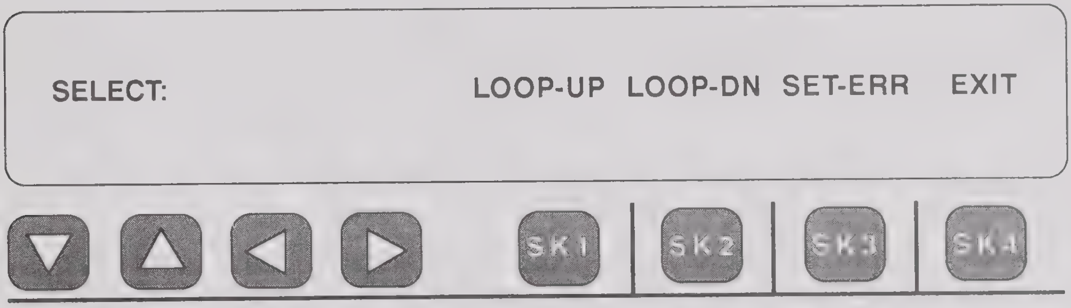
6-18.2.1 POINT-TO-POINT BER TESTING USING TWO 930As



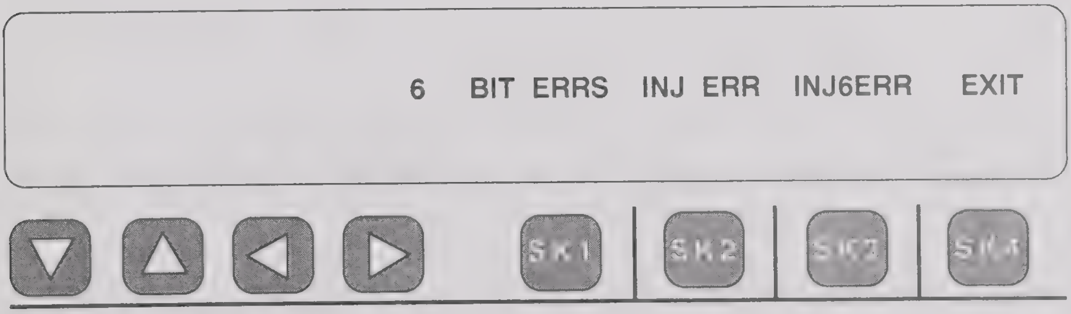
If you were testing point-to-point over a T-1 span and simply wanted to measure the Bit Error Rate on one of the channels you could do this by simply having a 930A at each end of the span. Set the 930As to send on the same channel and then set them both to send the same pattern toward each other. Both units would normally also be set to EXTERNAL Clock in the PCM TRUNK TYPE display. In some cases it may be necessary to have one 930A supply the clock and so one unit would be set to INTERNAL Clock.



Ideally, you would achieve sync and there would be no bit errors on the main display. To test the integrity of the connection you might force some errors over the channel under test to see if they get counted properly. You press Softkey 4 under **MENU** and the display would show:



Pressing Softkey 3 under **SET-ERR** allows you to send a single bit error or 6 bit errors at a time.



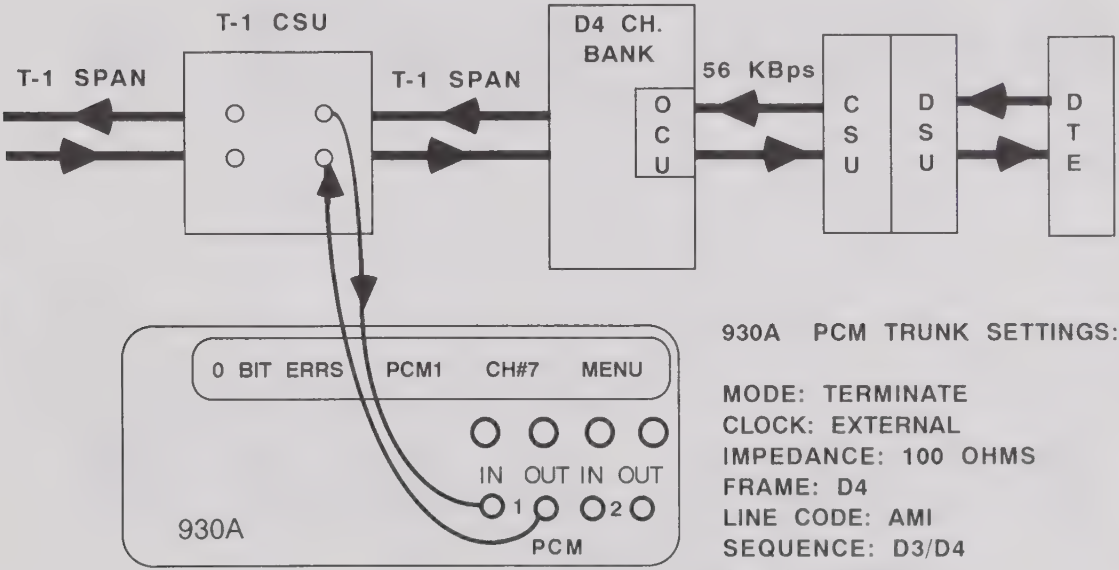
From this display you can count errors as well as inject them. If you press Softkey 4, you exit back to the main display.

You can also force one of the 930As to throw a **loopback** on the DS-0 channel under test. You can do this by first selecting **Menu Option 57: DS-0 LOOPBACK** and then selecting Digital Loopback. The channel you have selected under the PCM Trunk Type will then be looped back. The other 23 channels will remain as they were. **DO NOT USE** the VF Loopback except for analog tones. VF Loopback will not work with digital BER patterns. You can also access your selection from **Menu Option 4: DIGIT RECEIVER** as described in Section 4-1.

6-18.2.2 LOOPBACK BER TESTING ON 56 KBps DDS TRUNKS

Bit Error Testing on Dataphone Digital Service® (DDS) is in many ways easier than point-to-point testing. This is because DDS equipment responds to digital loop-up and loop-down commands. That means you can test from one 930A into the DS-0 channel and there is no need to have another 930A at the far end.

Again, the first step is to set up the 930A to either terminate the T-1 span or for Drop and Insert. You can connect the test cords at the DSX or at a T-1 CSU. The diagram below will serve as a discussion point.

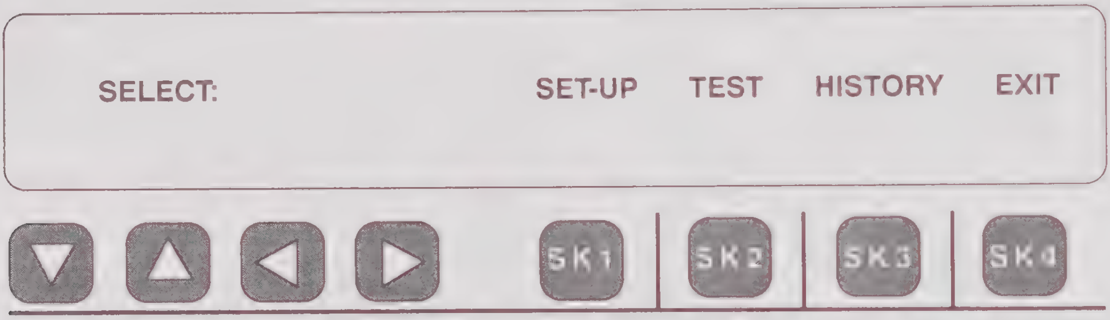


930A PCM TRUNK SETTINGS:

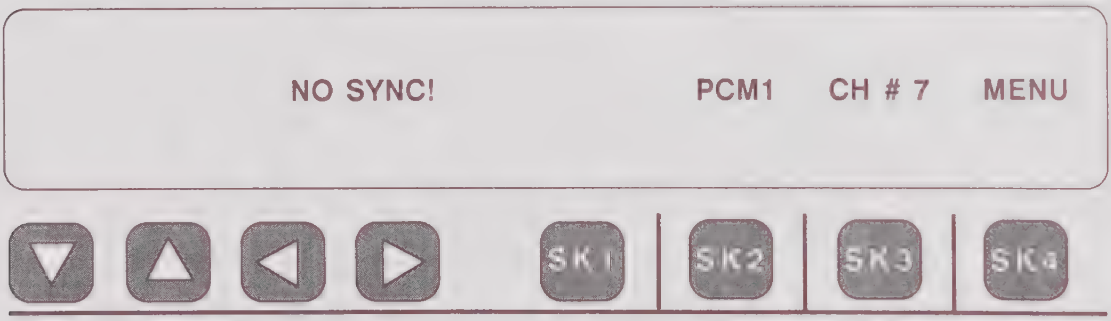
MODE: TERMINATE
CLOCK: EXTERNAL
IMPEDANCE: 100 OHMS
FRAME: D4
LINE CODE: AMI
SEQUENCE: D3/D4
SUPV: NORMAL

In this case the equipment side of the T-1 CSU is connected to a D4 channel bank which in turn feeds a 56 KBps OCU on Channel 7 to a CSU/DSU. Testing would normally begin by looping the DSU back and running a BER test for 15 minutes or so with a number of different stress patterns. If errors are not encountered the trunk is probably good. If errors are encountered then you must successively loop back the equipment on the trunk to determine where the problem is. If you loop back the 56 KBps CSU next, repeat the test patterns and find no errors, then the DSU is bad. If the errors still persist, then loop back the OCU. If you get errors then the OCU is bad. If you do not get errors, then it is a safe bet that the CSU is bad or the line interface connection to it is bad.

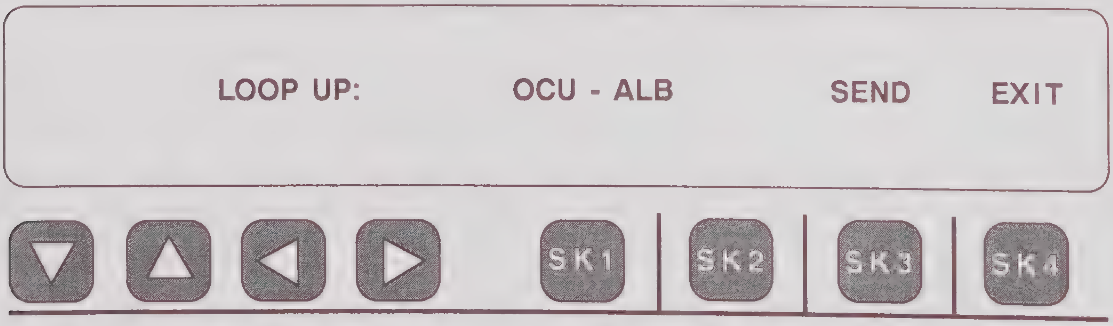
A brief run down on how to perform loop-back testing with the 930A follows. First, you begin with connecting the 930A to the T-1 span as previously described. Then you select Menu Option 56: DS-0 BERT. You enter the SET-UP menu and select the stress pattern you wish to send or create your own from the USER selection. At this point you return to the main menu by pressing the OPTION MENU key once. The display should be:

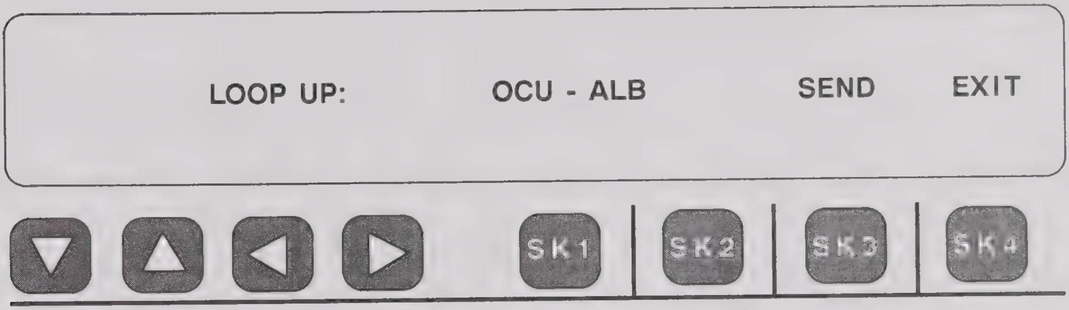


Next, press Softkey 2 under **TEST** and the main BER display will appear.



In this case we have **NO SYNC** because we have not yet looped back the far end device. No pattern is being returned to sync on. To loop the far end device, you press Softkey 4 under **MENU** and the following display appears:



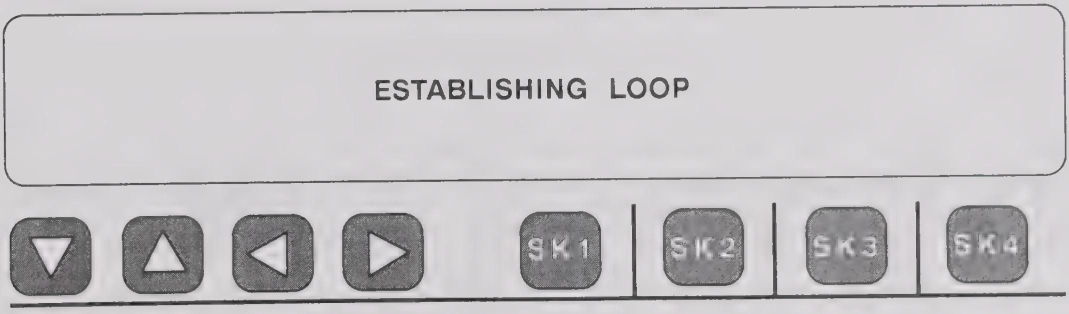


LOOP UP: OCU - ALB SEND EXIT

The loop-back patterns which the 930A can send are:

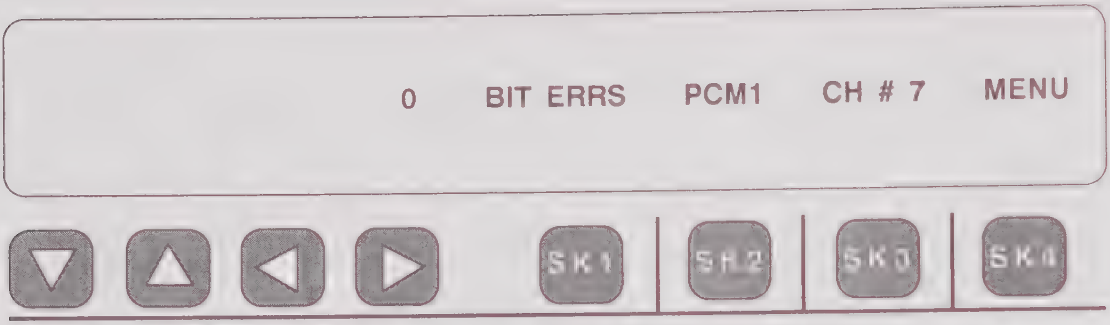
OCU-ALB	OCU Alternating Loopback
CSU-ALB	CSU Alternating Loopback
DSU-ALB	DSU Alternating Loopback
Repeater 1-ALB	Repeater 1 Alternating Loopback
Repeater 2-ALB	Repeater 2 Alternating Loopback
DP DROP-LLB	Dataport Drop-Latching Loopback
OCU-LLB	OCU Latching Loopback
CSU-LLB	CSU Latching Loopback

Select the correct pattern for your application by pressing Softkey 1 or using the UP/DOWN arrow keys. When the correct pattern is displayed, press Softkey 3 under **SEND** and the pattern will be transmitted. The 930A will respond with a screen:

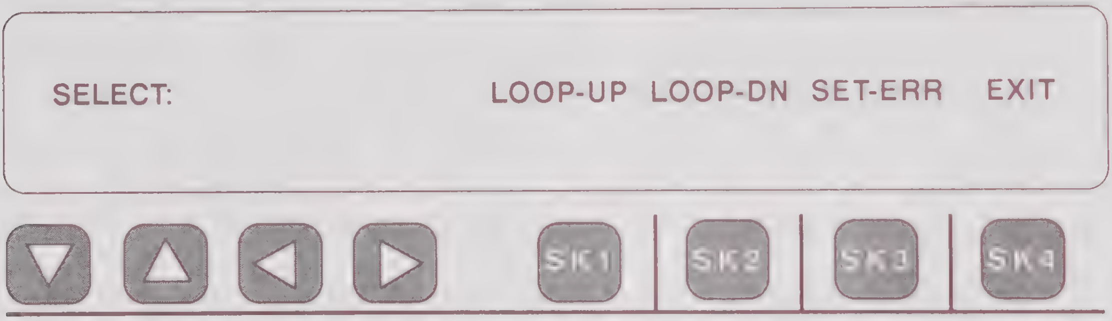


ESTABLISHING LOOP

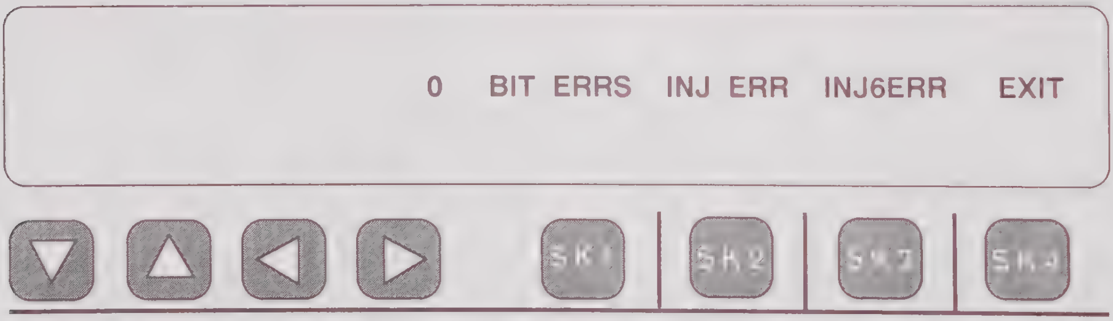
When the loopback is successful, the 930A display will show the main BER display screen.



Note that the **NO SYNC** indication has now been replaced by the Bit Errors count. To test the integrity of the loop, you can send a single error to see if it comes back. Press Softkey 4 under **MENU** and go to the **SET-ERR** function.



Press Softkey 3 under **SET-ERR** and the display changes to:

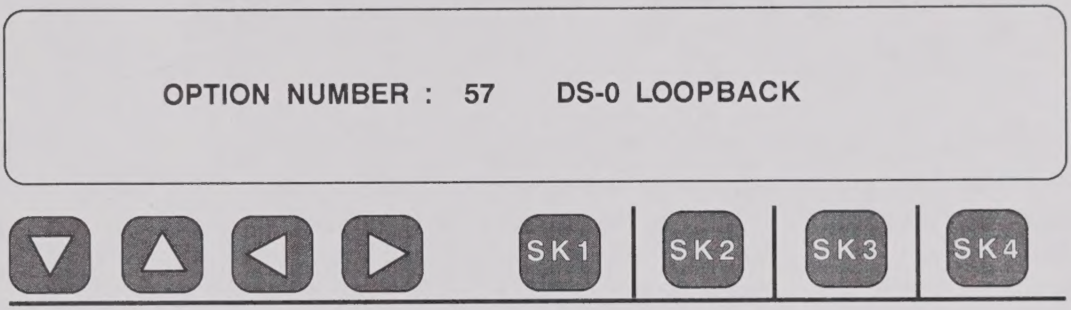


At this point you can press Softkey 2 under **INJ ERR** and a single error will appear on the display if you have loop integrity.

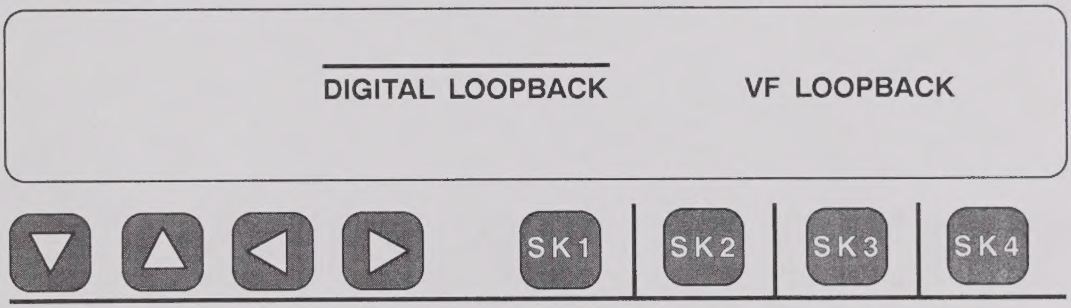
You can change test patterns if you wish by re-entering the set-up menu. Whatever you do, the 930A will resend the selected loopback code automatically when you re-enter the **TEST** menu.

6-18.3 HOW TO MAKE THE 930A GIVE A LOOPBACK

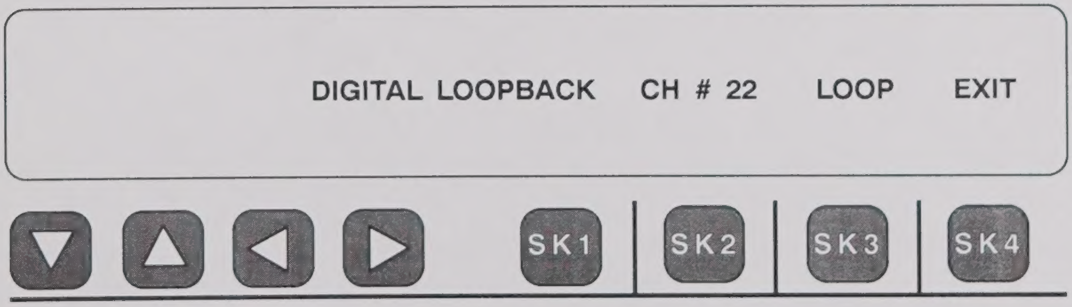
The 930A can loop back the selected PCM channel in TERMINATE or Drop and Insert modes. This is similar to a hard loopback in operation because no codes are involved. You simply select **Menu Option 57: DS-0 LOOPBACK**.

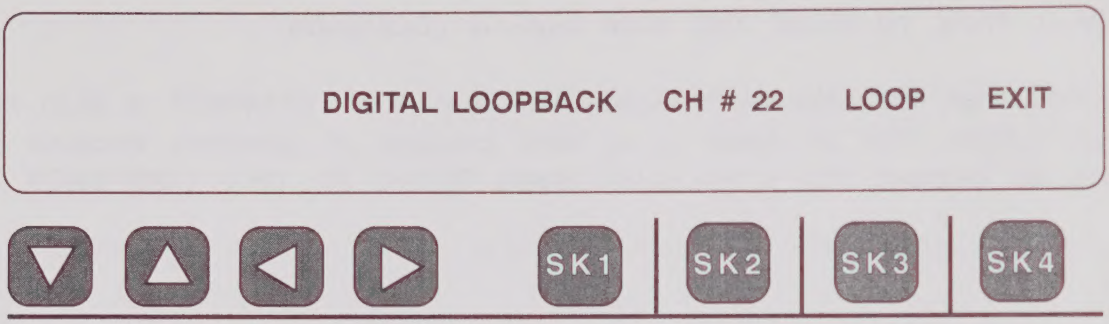

OPTION NUMBER : 57 DS-0 LOOPBACK

Pressing any softkey will bring up the loopback selection display:


DIGITAL LOOPBACK VF LOOPBACK

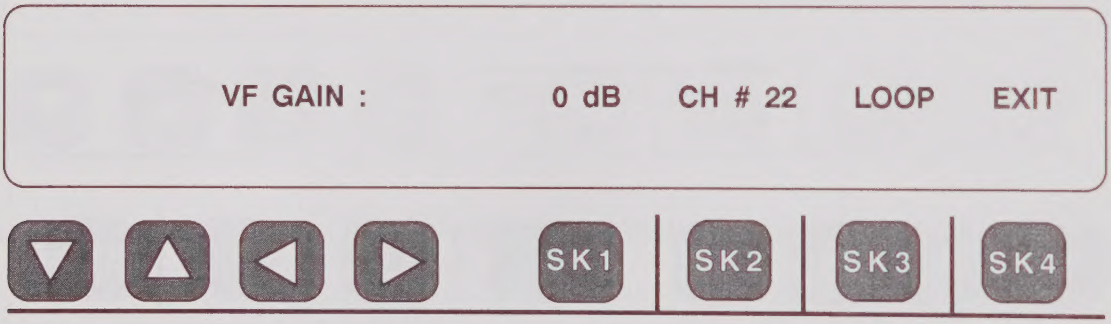
The default is **DIGITAL LOOPBACK**. This is the type you must choose if digital patterns are going to be looped back. That is, pseudo-random patterns such as the 511 or 2047 bit long patterns. If tones (e.g., 1004 Hz) are being sent toward you then you want to choose the **VF LOOPBACK**. Select **DIGITAL LOOPBACK** by pressing Softkey 1 and the display will become:


DIGITAL LOOPBACK CH # 22 LOOP EXIT



To initiate a loopback press Softkey 3 under **LOOP** and a cursor will appear over **LOOP** indicating that the selected channel has been looped back. In this example, Channel 22 has been looped back since it was the selected channel in trunk type. To loop back a different channel you must return to the PCM Trunk Type menu and change the channel there.

If you select **VF LOOPBACK** instead, the display is somewhat different:



Here, you have the opportunity to insert gain or attenuation. The default is 0 dB but you can enter any number between +2 dB and -16 dB by pressing Softkey 1 and then using the keypad to enter the desired value. The VF Loopback also retains the companding algorithm which is suspended during a digital loopback.

To initiate a VF Loopback, press Softkey 3 under **LOOP** just as you would for a digital loopback.

Pressing Softkey 4 under **EXIT** will take down the loop and return the 930A to its normal state. Note that only the selected channel is looped. The other 23 channels pass through unimpaired.

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